2018

Multidimensional Knowledge Flow Dynamics in Context

Lina Lo
Nova Southeastern University, lina_lo@ymail.com

Multidimensional Knowledge Flow Dynamics in Context

by
Lina Lo

A dissertation submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy
in
Information Systems

College of Engineering and Computing
Nova Southeastern University

2018

We hereby certify that this dissertation, submitted by Lina Lo, conforms to acceptable standards and is fully adequate in scope and quality to fulfill the dissertation requirements for the degree of Doctor of Philosophy.

Timothy J. Ellis, Ph.D.
Chairperson of Dissertation Committee

7 FEB 2018
Date

Donald McKay II, Ph.D.
Dissertation Committee Member

7 Feb 2018
Date

Steven R. Terrell, Ph.D.
Dissertation Committee Member

7 Feb 2018
Date

Approved:

Yong X. Tao, Ph.D., P.E., FASME
Dean, College of Engineering and Computing

7 Feb 2018
Date

College of Engineering and Computing
Nova Southeastern University

2018

Abstract

An Abstract of a Dissertation Submitted to Nova Southeastern University
in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

Multidimensional Knowledge Flow Dynamics in Context

by
Lina Lo
December 2017

Knowledge is a sustainable advantage and knowledge assets can increase value with use. A snowball effect of knowledge advantage advocates effective knowledge management and fosters its continual growth as it flows. Knowledge, however, flows unevenly throughout an organization and the problem is that the fundamental dynamics of these flows are still not well characterized in theoretical and computational models.

This study built on existing work—knowledge-flow theory, need knowledge generation, and the critical success factors for enterprise resource planning implementation—to examine the multidimensional knowledge-flow phenomenon in context, and used the case study methodology for knowledge-flow theory building. The research question was two-pronged: how can need knowledge and its flow across stakeholders within an organization be explained using a multidimensional knowledge-flow model and how can Nissen's five-dimensional knowledge-flow model be validated using a real-life immersion case?

The researcher relied on three sources of evidence for this case study: project-related documentation, archival records, and interviews. Data triangulation yielded three results components: (a) a chronology of key events that obstructed knowledge flow, (b) a logic model depicting themes that contributed to knowledge-flow obstruction, and (c) explanations of the knowledge-flow patterns.

This case study suggested enabling need knowledge determinants and obstructing conditions are in play that determine the path of need knowledge flow. These two research artifacts should be considered together to provide a fresh research avenue towards better understanding of knowledge flow dynamics.

Acknowledgments

This research is the culmination of fifteen years of endeavor. Along the way, I have collected a great deal of intellectual and emotional debts. My greatest intellectual debt is to Dr. Timothy Ellis, who steered me on course throughout the dissertation process and shaped my understanding of the analytics in knowledge management. I am also very grateful to my committee members, Dr. Steven Terrell and Dr. Donald McKay, whose valuable insights and expert advice helped strengthen the final dissertation report.

Many other people played important roles in encouraging and challenging me over the years. I would particularly like to thank Dr. Amon Seagull, Dr. Sumitra Mukherjee, Dr. Steven Zink, Dr. Marlyn Littman, and Dr. Ling Wang.

I could not have completed this Ph.D. journey without my husband Maurice Knight by my side. Maurice has been wonderfully supportive. His persistent nudging, sent from all corners of the world, from the middle of the Pacific to sub-Saharan Africa, was at once exasperating and inspirational. This work is dedicated to Maurice.

Table of Contents

List of Tables

Tables

List of Figures

Figures

Chapter 1

Introduction

Background

Knowledge is a source of organizational competitive advantage, but flows unevenly throughout an organization (Nissen, 2002, 2006a, 2014; Nonaka, 1994; Pourzolfaghar, Ibrahim, Abdullah, Adam, & Ali, 2013). Nissen (2014) defined knowledge flow as the dynamic movement of knowledge between individuals, organizations, points in space, or time. Inefficient knowledge flow hinders an organization's ability to realize its potential. Despite more than 2 decades of knowledge-management (KM) practice to leverage knowledge for an organization's competitive advantage, the current state of KM remains ineffective and uninformed across organizations and sectors (Nissen, 2014).

Uneven knowledge flows are particularly pronounced in complex enterprises and initiatives (Pourzolfaghar et al., 2013). The researchers studied knowledge flows between two types of architectural experts during the design phase of a building project. Enterprise resource planning (ERP) is a packaged integrated business process-oriented software information system (IS) that enables an enterprise to manage the efficient and effective use of its resources (Nah, Lau, & Kuang, 2001). ERP systems applied in the public sector are often limited to budget and treasury components of public financial operations, and are referenced as financial-management information systems (FMIS) that enable governments "to plan, execute, and monitor the budget by assisting in the

prioritization, execution, and reporting of expenditures as well as the custodianship and reporting of revenues" (Dener, Watkins, & Dorotinsky, 2011, p. 1). ERP implementations are complex and costly endeavors. These are lengthy initiatives that can take on average 23 months to complete in the private sector with some preimplementation lead time for the selection of vendors and implementers (Umble, Haft, & Umble, 2003). ERP implementations generate marked amounts and channels of knowledge flow.

KM has long been used to enhance ERP implementation (Liu, 2011; McGinnis & Huang, 2007; O'Leary, 2002) and to explain some of the difficulties in realizing ERP projects and benefits (Guo, Feng, & Wang, 2014; Jones, Cline, & Ryan, 2006; Palanisamy, 2008; Vandaie, 2008; Wang, Lin, Jiang, & Klein, 2007). Nour and Mouakket (2011) proposed a framework of critical success factors (CSFs) for ERP implementation in three dimensions: (a) six fundamental stakeholders (end users, top management, information-systems department, project team, organization, and vendor), (b) three major phases of an ERP project life cycle (preimplementation, main implementation, and postimplementation), and (c) five different roles each stakeholder may play during each ERP-implementation phase (consultation, participation, fulfillment, authorization, and support). Some researchers stressed that the efficacy of various knowledge flows hinged on contextual factors (Dener et al., 2011; Nissen, 2014).

International financial institutions (IFIs) such as the European Investment Bank, The World Bank, and the Asian Development Bank provide financing and technical advisory support to developing countries. In 2004, a developing country and an IFI signed an initiative, referenced throughout this report as the Reforming Public Financial Management Project or REPFMP, intending to reform the country's public financial

management system spanning a decade with an ERP system as the initiative's core deliverable. It took 11 years for the resulting ERP system to become operational. REPFMP is this country's first ERP implementation that aims to enhance government efficiency and effectiveness in the comprehensive management of public resources. The REPFMP initiative, with its multitude of stakeholders and corresponding implementation complexities, presents a rich environment to better understand knowledge-flow dynamics and enables stakeholders "to translate theory into practice and inform practice with theory" (Nissen, 2014, p. 235).

Problem Statement

Knowledge flows unevenly throughout an organization. The problem is that the fundamental dynamics of these flows are not well characterized in theoretical and computational models (Kim, Hau, Song, & Ghim, 2013; C. Lin, Wu, & Tsai, 2013; Nissen, 2014). C. Lin et al. (2013) noted that the "research approach of dealing with KM issues often fails to grasp, especially, the issues of knowledge flow" (p. 629). Nissen (2014) portrayed the state of KM research as mostly descriptive in nature and presented that the next generation of KM research should move toward measurement, explanation, and prediction, stating "learning from failure can provide important lessons, but such provision depends critically upon knowing what causes failure (e.g., preconditions) and learning how it can be prevented" (p. 236). Nissen highlighted the importance of identifying and distinguishing "the contextual factors that affect the efficacy of various knowledge flow processes" and encouraged researchers "to immerse themselves in operational organizations in the field and to investigate how people as individuals, in groups, in organizations, and in even larger collectivities know and learn" (2014, p. 236).

Some researchers attempted to build conceptual knowledge-flow theory. C. Lin et al. (2013) identified a number of factors or determinants—transfer, source, receiver, and flow context—that affected knowledge flow, and proposed a hybrid model that included a triangulation scheme to illustrate the multidirectional nature of and adaptive interactions among the determinants of knowledge flow. Kim et al. (2013) developed a tool based on social-network analysis to trace organizational knowledge paths to identify where and how knowledge flows and stops. Nissen (2014) proposed a five-dimensional (5D) knowledge-flow model to characterize a particular knowledge and represent the efficacy in achieving a knowledge-based action. Nissen described knowledge characters in four dimensions: explicitness (explicit versus tacit knowledge), reach (from individual to group to organization to interorganization), lifecycle (activities associated with knowledge flows such as creation, sharing, or application), and flow time (in minutes, days, or years), and denoted efficacy of a knowledge-based action by a fifth dimension: the knowledge-power dimension. Real-life case applications can further strengthen this 5D model formulation.

Dissertation Goal

The goal of the study was to validate and extend Nissen's (2014) 5D model using a real-life ERP initiative to examine the uneven flow of knowledge through an organization. Pourzolfaghar et al. (2013) developed a technique to capture required (or need) knowledge of two different types of experts (or stakeholders) during the architectural conceptual-design phase of a green-building project to improve knowledge flow among these two sets of stakeholders based on an earlier four-dimensional knowledge-flow theoretical framework proposed by Nissen (2002, 2006b). Pourzolfaghar

et al. found that knowledge flows along the critical paths of workflows contributed positively to organizational performance, as posited by Nissen (2006b, 2014). Therefore, Pourzolfaghar et al. concluded, "knowledge flows should be planned and managed like workflows" (2013, p. 75).

Kaiser, Fordinal, and Kragulj (2014) furthered the concept of required or need knowledge, independent of the work by Pourzolfaghar et al. (2013), and built a theoretical framework to capture (create and discover) need (or required) knowledge in an organization for the generation of innovative products and services. Kaiser et al. integrated the theory of needs into the theory of knowledge-based organizations. In their premise, Kaiser et al. proposed that needs are "requirements to be met for the individual's well-being and the organization's sustainable existence" (2014, p. 3501). Kaiser et al. showed their model successfully discovered and generated need knowledge in large organizations in a short time frame. Pourzolfaghar et al. and Kaiser et al. reinforced Jennex's (2008) description of KM as "getting the right knowledge to the right people at the right time" (p. 52). It follows that it is more efficient for an organization to focus on need knowledge and move it through the knowledge flow for the relevant stakeholders.

This study extended Nissen's (2014) 5D knowledge-flow model as the theoretical framework that explained the flow of need knowledge, described by Pourzolfaghar et al. (2013) and Kaiser et al. (2014), across Nour and Mouakket's (2011) six fundamental stakeholders of an ERP project. Hanisch, Lindner, Mueller, and Wald (2009) linked knowledge to project life cycle, stating that different stages of a project life cycle need different types of knowledge, and therefore connected Kaiser et al.'s (2014) need knowledge to Nour and Mouakket's (2011) CSF framework.

The Reforming Public Financial Management Project (REPFMP) initiative provided fertile ground for this study of the multidimensional knowledge-flow phenomenon. REPFMP took 6 years to complete, from conception to the beginning of ERP-system implementation, with 4.5 years spent on procurement, resulting in a total project life of well over a decade. Although the lifetime of REPFMP is not an anomaly among the 87 implementations studied by Dener et al. (2011), REPFMP took longer than average to gain traction. Dener et al. noted that effective FMIS (ERP) design and implementation required contextual and country-specific solutions, which echoed Nissen's (2014) assertion of a "contextual factors" requirement in knowledge-flow processes.

Poon and Yu (2010) considered procurement an important preimplementation component of ERP adoption and studied practices in Hong Kong and Australia. Negi and Bansal (2013) cited that the two most crucial and expensive knowledge phases in a successful ERP implementation lifecycle were requirements engineering and configuration. These preimplementation stages of an ERP implementation are pivotal moments (Dawson & Owens, 2008; Dener et al., 2011). The study concentrated on the preimplementation phase of the ERP-implementation lifecycle. In sum, the research comprised an explanatory single-case study, as described in Yin (2014), to understand the phenomenon of knowledge-flow dynamics across different stakeholder groups over the preimplementation period of a real-life ERP implementation.

Research Questions

Pourzolfaghar et al. (2013) used Nissen's (2006b) multidimensional knowledge-flow model as the background theory for their study of need knowledge and its

movement between experts to avoid rework due to ineffective KM. The researchers extended the activity-based architectural-design framework developed by Macmillan, Steele, Austin, Kirby, and Spence (2001), which merged the theory of knowledge flow with the theory of architectural design. Their work further demonstrated the linkages between knowledge flow and workflows and the multidimensionality of knowledge flow in high-performing organizations. Although usually multiple stakeholders participate in a complex project such as the building project described by Pourzolfaghar et al., the researchers focused on explicating only mechanical and electrical need knowledge and the related flows among mechanical and electrical engineers during the architectural conceptual-design phase of a green-building project in Malaysia.

Kaiser et al. (2014) focused on needs and knowledge about needs in organizations and developed a framework for the creation and discovery of need knowledge grounded in abductive reasoning; a process that "relies on observations to stimulate possible hypotheses …" (with) "an appeal to instinct" (p. 3501). Next, the researchers applied the framework to a large project in Austria to create a catalog of needs for Austrian bakers. The bakers role-played as four different sets of stakeholders during the study: customers, owners or chiefs of bakeries, employees of bakeries, and the Austrian Federal Economic Chamber, the institution that initiated the project. Contributions of the Kaiser et al. study are twofold: integrating the theory of needs into the theory of knowledge-based firms, and using abductive reasoning in the generation of need knowledge. However, the researchers applied the framework developed and described in the study to only one case during a singular moment in a workshop setting.

Kaiser et al. (2014) and Pourzolfaghar et al. (2013) presented a new process of need-knowledge explication through innovative merging of disciplines with limited empirical work to validate the generalizability of the approaches across organizations and industries. Each group of researchers focused on tacit knowledge, only hinted at the multidimensionality of knowledge-flow dynamics in organizations, and used instances outside the realms of IS. When collectively considered, in addition to Nissen's (2014) 5D knowledge-flow model and Nour and Mouakket's (2011) ERP CSF classification framework, a blank canvas emerged for further elaboration, especially in information-systems research. In this context, the main research gap is the lack of empirical work to explain multidimensional knowledge-flow phenomena.

Existing frameworks on need-knowledge generation (Kaiser et al., 2014; Pourzolfaghar et al., 2013), knowledge-flow theory (Nissen, 2014), and the ERP CSF classification structure (Nour & Mouakket, 2011) provided the foundation for this study, to explain the multidimensional knowledge-flow phenomenon in context, using the preimplementation phase of the REPFMP as a real-life immersion case for knowledge-flow theory building. This study validated Nissen's (2014) model by successfully using the model to explain real-life knowledge flows. Accordingly, this study consisted of two-fold mutually reinforcing research questions:

1. How can need knowledge and its flow across different stakeholders in an organization be explained using a multidimensional knowledge-flow model?
2. How can Nissen's (2014) 5D knowledge-flow model be validated using a real-life immersion case?

Relevance and Significance

Knowledge is a sustainable advantage and, unlike physical assets, knowledge assets can increase in value with use (Davenport & Prusak, 2000). A snowball effect of knowledge advantage leads to the concept that knowledge needs to be applied for its value to be extracted (Nissen, 2006a). Knowledge flows unevenly across people, organizations, places, and time. However, knowledge may not be equally valuable (or needed) throughout its flow (Haas & Hansen, 2005). Effective KM is necessary to foster its continual growth as it flows. Despite well-established knowledge-flow theory and 20 years of practice and research, KM remains understudied (Nissen, 2014). There is a dearth of theoretical and computational models to concretize the fundamental dynamics of knowledge flows.

Researchers of recent studies on knowledge flow recognized the dynamic and elusive nature of knowledge flow and attempted to present approaches to better understand the knowledge-flow phenomenon. However, the current body of research tends to center on one or two aspects of knowledge flow (Kaiser et al., 2014; Kumar, 2013; Pourzolfaghar et al., 2013), using only one organization or sector (Kaiser et al., 2014; Pourzolfaghar et al., 2013), or just one country (C. Lin et al. 2013; Pourzolfaghar et al., 2013).

The goal of this study was to explain why knowledge flows differently across different stakeholder groups. The use of a multidimensional knowledge-flow model generalized how knowledge flows across different stakeholders in an organization over time using a real-life ERP initiative. The contributions of the study are three-fold. First, the work validated Nissen's (2014) proposed 5D knowledge-flow model, which has

limited empirical work, by considering the multidimensional aspects of knowledge flow in a real-life ERP project. Second, the research adopted five of six stakeholder groups defined by Nour and Mouakket (2011), thereby expanding on Pourzolfaghar et al.'s (2013) work with only two stakeholder groups. Third, the study was longitudinal, covering the multiyear preimplementation phase (2004–2009) of an ERP initiative, departing from the work of Pourzolfaghar et al. (2013) and Kaiser et al. (2014) who considered relatively shorter time horizons.

Barriers and Issues

Following the Asian monetary crisis of the late 1990s, the country in this study embarked on transitioning into a major reform program by unleashing a mixture of socioeconomic policies to ensure (a) macroeconomic stability; (b) financial-sector reform; and (c) increased investment, exports, and employment opportunities. This transition resulted in a hesitant political environment moderated by a strong incentive for change or reform. REPFMP was one of the answers to drive reform. REPFMP closed at the end of 2015 after more than 10 years spanning multiple presidential elections, ministers of finance, and project managers from the IFI financing the project, with the inevitable corresponding change in team members. Ibrahim and Nissen (2007, as cited in Pourzolfaghar et al., 2013) posited that knowledge did not flow well and deteriorated further from discontinuous team members participating in knowledge exchange. The lengthy 6-year preimplementation period for REPFMP can be attributed to a continuously peripatetic stakeholder membership in an initiative as complex as an ERP implementation against a backdrop as contentious as state building.

Assumptions, Limitations, and Delimitations

The explanatory single-case study was a postmortem analysis based partly on individual memories, with details selectively edited or otherwise corrupted by more recent events. Triangulation of multiple sources of evidence addressed the anticipated limitation. The evidence included project-related documentation and archival records created at the time or close to the time the events took place. C. Lin et al. (2013) adopted the triangulation approach to study knowledge flow to handle various interactions among a multitude of stakeholders in numerous contexts associated with KM. The complexity of the study hinged on the process of aggregating and triangulating multiple sources of evidence from diverse contexts to extract the knowledge-flow dynamics against the 5D knowledge-flow model that has yet to be tested. Furthermore, the researcher of this study assumed that participants selected for the study made a sincere effort to provide the most accurate memory-based knowledge of the events related to the study case. Importantly, because the study focused on one specific case and consisted of nearly 5-years of preimplementation over a 10-year span, the generalizability of the work in the context of KM research and other cultural and economic environments might not be fully robust.

Definition of Terms

Enterprise resource planning (ERP) is a packaged process-oriented business software that supports an enterprise to efficiently and effectively manage and use its resources such as materials, human resources, and finance (Fotini, Anthi-Maria, & Euripidis, 2008; Nah et al., 2001).

Financial-management information system (FMIS) refers to a set of automated solutions that enable governments to plan, execute, and monitor the budget by assisting in

the prioritization, execution, and reporting of expenditures, as well as the custodianship and reporting of revenues (Dener et al., 2011).

Five dimensions of knowledge flow refers to the explicitness, reach, life cycle, flow time, and power dimensions to classify and visualize knowledge flows (Nissen, 2014).

Knowledge flow is the dynamic movement of knowledge between individuals, organizations, points in space, or time (Nissen, 2014).

Need knowledge is the required knowledge to maintain an individual's well-being and an organization's sustainable existence (Kaiser et al., 2014).

Preimplementation phase of an ERP project is the period when project activities aim to prepare for and set the stage for the main implementation phase. The preimplementation phase includes identification, evaluation, and purchase of the ERP software product (Nour & Mouakket, 2011).

List of Acronyms

5D	five dimensional
BRIC	Brazil, Russia, India, and China
CSF	critical success factor
DAMC	data activity model for configuration
ERP	enterprise resource planning
FCA	formal concept analysis
FMIS	financial management information system
ICT	information communications technology
IFI	international financial institution

IRB	institutional review board
IS	information systems
IT	information technology
IU	intention to use
IVV	independent validation and verification
KM	knowledge management
MNC	multinational corporation
PEOU	perceived ease of use
PU	perceived usefulness
REPFMP	Reforming Public Financial Management Project (fictionalized name of the ERP project under study)
SECI	socialization, externalization, combination, and internalization

Summary

Knowledge is a sustainable advantage and knowledge assets increase in value with use. A snowball effect of knowledge advantage advocates effective KM to foster its continual growth as it flows. Knowledge, however, flows unevenly throughout an organization and the problem is that the fundamental dynamics of these flows are still not well characterized in theoretical and computational models. This case study aimed to build on existing work—knowledge-flow theory, need-knowledge generation, and the critical success factors for ERP implementation—to examine the multidimensional knowledge-flow phenomenon in context using a real-life immersion case for knowledge-flow theory building.

The next chapter provides a literature review of knowledge-flow dynamics in the KM research realm and ERP implementation. Chapter 3 details steps and resources used to conduct the case study that addressed the research questions posed. Chapter 4 presents the findings and analysis of the study. Finally, Chapter 5 offers conclusions, recommendations, and a summary.

Chapter 2

Review of the Literature

The literature review is organized into two research streams, KM and ERP implementation, building a foundation to study the uneven flow of knowledge through an organization using a real-life ERP initiative (see Figure 1). The first part of this chapter addresses KM as a discipline, elucidating key aspects of emerging research, particularly in knowledge flows. Following the nomenclature in Nissen's (2014) multidimensional knowledge-flow model, each of the subsequent five segments respectively discusses each of the five knowledge-flow dimensions—reach, explicitness, life cycle, time, and power—as represented in the literature. The second part of the review of the literature addresses the second research stream by establishing ERP implementation as an appropriate laboratory to study the multidimensionality of knowledge flow. This segment of the review starts with the CSF of ERP implementation and the role of KM in its successful implementation and ends with a discussion of ERP implementation in the public sector or in developing countries: that is, the specific setting of the real-life case for the proposed study.

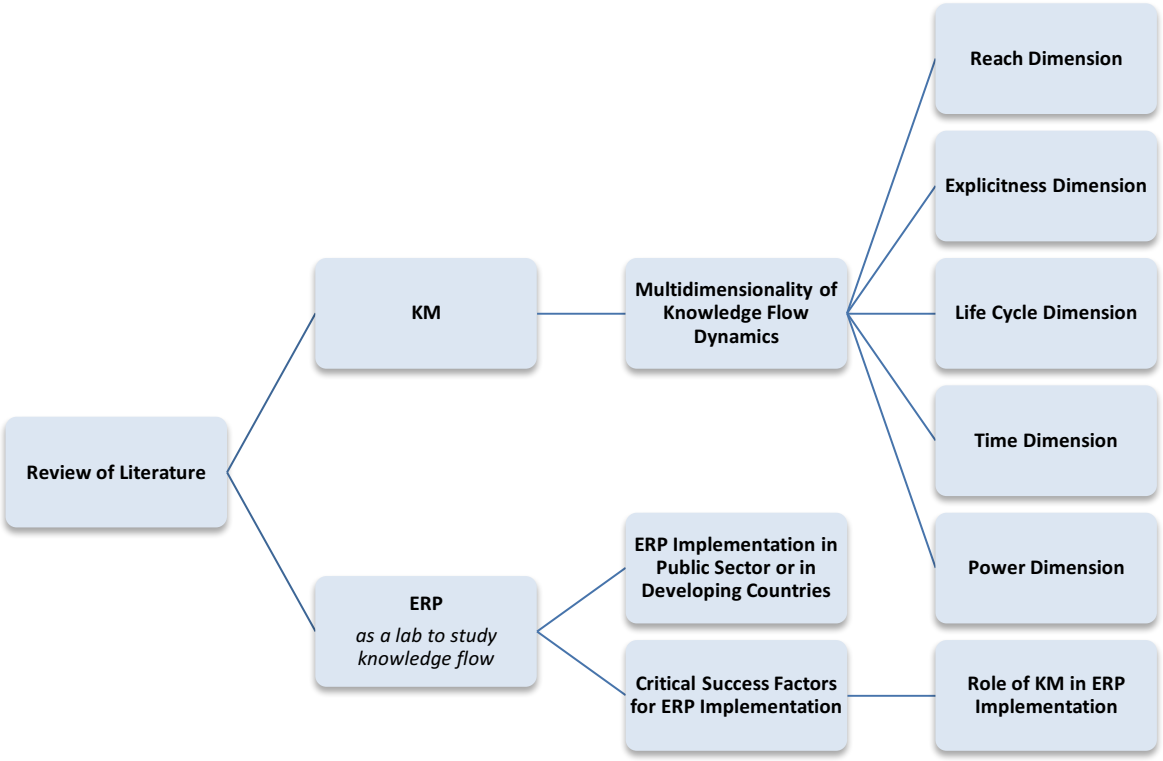

Figure 1. Overview of the Review of the Literature

Knowledge Management

Serenko and Dumay (2015a, 2015b, 2017) identified and analyzed more than 100 articles published in 25 KM-centric academic journals between 1997 and 2009, based on their citation impact generated by Google Scholar to better understand KM as a discipline and its research trends. The researchers defined works with high citation counts as citation classics. In the first part of a four-part study series presented by Serenko and Dumay (2015a), the authors formulated the development of KM as a discipline based on the attributes of KM citation classics. In the second study, Serenko and Dumay (2015b) extended the findings from the first study and postulated the KM research trends. In the

recently published third study, Serenko and Dumay (2017) investigated why these KM citation classics were well-cited.

Serenko and Dumay (2015a) developed a list of attributes of KM citation classics by adapting a methodology used in published work. This part of the research consisted of four stages: (a) they formulated the research framework based on the model by de Villiers and Dumay (2013, as cited in Serenko & Dumay, 2015a) as the basis for the need to understand KM citation classics; (b) they extracted articles from 25 KM-centric journals containing 145 or more citations as of January 3, 2014; (c) they pilot-tested the initial research framework by coding 12 of each authors' articles and compared the results to fine-tune the framework to include new categories; both authors then coded the remaining articles; and (d) they identified emerging patterns from the articles using descriptive statistics. The authors adopted seven attributes of the KM citation classics: articles' publication year, research methods used, themes of the articles, KM frameworks/models used, theories applied, article attributes (number of words and number of citations), and authors.

Based on the four-stage research process, the analysis included 100 citation classics. Serenko and Dumay (2015a) found a concentration of articles published between 1999 and 2003, a period when skeptics of KM debated whether it was another management fad. The researchers argued against this position, given the significant number of articles published after 2003. Serenko and Dumay (2015a) noted that researchers used literature reviews (52 articles) most often, followed by case studies (20 articles), and surveys (18 articles). The development of KM as a discipline seemed to still be in an embryonic stage due to limited empirical work during the studied period.

Serenko and Dumay (2015a) compiled nine themes addressed in the citation classics: knowledge as a process, managing/competitive advantage, organizational culture, information technology (IT), communities of practice, knowledge innovation, KM strategy, scientometrics, and problem solving. The authors recognized two dominant themes: knowledge as a process (47 articles) and managing/competitive advantage (39 articles). Organizational culture and IT (8 articles each) tied for third place. The authors asserted that the dominant themes further supported the maturing nature of KM as a discipline. They postulated that earlier articles provided the foundational context for potential applications of KM and later articles sought to solidify the discipline through literature reviews and empirical studies.

A majority of the articles (51) proposed new KM frameworks or models for KM research. However, this trend declined over time, as authors increasingly applied previously proposed theories (Serenko & Dumay, 2015a). After 2003, the citation classics focused less on Nonaka's (1994) dynamic theory of organizational knowledge creation. In fact, 65 articles applied no existing theory; this atheoretical trend continued throughout the studied period. The citation classics contained another attribute: articles authorship started trending toward multiauthor articles between 1997 and 2003. More than 50% of authors resided in the United States and the United Kingdom. In addition, 20% of authors practiced outside of academia whereas 40% of authors collaborated from different institutions.

Serenko and Dumay (2015a) concluded that the KM discipline remained at the prescience stage, though moved toward academic maturity. Serenko and Dumay (2015a) noted the authors of dominant theories in citation classics relied on Nonaka's (1994)

dynamic theory of organizational-knowledge creation as their foundation. This theory is a resource-based view of the firm and learning theories. However, researchers most often applied these theories prior to 2005. The majority of citation classics applied an atheoretical foundation. These atheoretical citation classics appeared continuously between 1997 and 2009. Serenko and Dumay (2015a) deduced that understanding KM as a concept that contributes to theory and practice of KM and to further the discipline toward a normal science required empirical research. Nissen (2014) agreed with this claim, asserting that KM research should move toward measurement, explanation, and prediction.

In the second installment of the four-part study, Serenko and Dumay (2015b) extended their previous work to explore "the growing, stable and declining research trends as evidenced by KM citation classics" (p. 1337). The authors conducted a longitudinal analysis in five steps using the same 100 articles and research framework as in Serenko and Dumay (2015a). First, they calculated the number of citations for each citation classic article since its publication each year, including the publication year based on Google Scholar. Second, they converted the number of citations each year into the percentage of the total number of citations as of January 3, 2014. Third, they aggregated the citation classics into the same nine themes identified in Senenko and Dumay (2015a): knowledge as a process, managing/competitive advantage, organizational culture, IT, communities of practice, knowledge innovation, KM strategy, scientometrics, and problem solving. Fourth, the authors calculated the average percentage of citations per theme per year between 1999 and 2013 and organized the results visually with one graph per theme. Fifth, the authors inspected and recorded the resulting line graphs.

Serenko and Dumay (2015b) hypothesized that high-quality work took a shorter time to become scientific in nature and the number of citations would peak between 3 and 7 years, then gradually decline. The authors found that 67% of all citation classics had second or bimodal citation distribution peaks. Surprisingly, they did not detect any significant growing, stable, or declining citation pattern. However, they did discover an increase in the number of erroneous citations in the KM discipline because of the emergence of the Google Scholar search engine. Because of the ranking scheme Google Scholar adopted, the top five articles resulting from any search were often the most cited articles, regardless of their relevance and contribution to the citing work. The authors termed this phenomenon the Google Scholar Effect.

In the third part of the four-part study series, Serenko and Dumay (2017) continued to build the profile of citation classics by focusing on the characteristics of authors, originality, attributes, impact of the articles, and follow-up work. The theoretical framework was accordingly constructed to comprise these five factors and each associated with multiple variables based on literature review. The factor of author characteristics associated with the most variables, 14 in total that included gender, age, education, country of residence, work history, career mobility, teaching experience, training of future researchers, scholarly output, literature awareness, industry-academia orientation, research motivation, collaboration preferences, and methodological preferences. Origin, serendipity, and acceptance were variables of the idea of the article, and utility, novelty, and timeliness characterized an article's attributes. The authors also included in their study framework the article's impact on academia as well as on practice, and whether there were subsequent publications, participation in peer reviews, or tracking

citing papers. Based on the five factors and associated variables above, Serenko and Dumay (2017) developed an online questionnaire and emailed that to the 129 of the 182 authors or coauthors of citation classics included in the first part of this study series (Serenko & Dumay, 2015a). Of the 129 emails sent, 26 bounced back and 58 responded yielding a 56% response rate. The authors analyzed the 58 responses using descriptive statistics and content analysis.

On the author characteristics, Serenko and Dumay (2017) found that 26% were females, and the average age of the authors was 57 with a range of 41 to 81 years old. Most (81%) of the authors had a doctoral degree, 17% had a master's and 2% an undergraduate degree. The authors also noticed that the majority of these authors of citation classics advanced through business/management and MIS/Computer Science/IT areas. These authors obtained their doctoral degrees in the United Kingdom, the United States, Canada, Denmark, and Australia, with 23% resided in the United Kingdom, 17% in the United States, 15% in Canada, 8% in Denmark, and 6% in Australia at the time of the survey. Majority (70%) of these authors had some industry connection. This aligned with KM being an applied management field. On the idea for the citation classics, Serenko and Dumay (2017) found that serendipity, or unplanned findings, played an important role during the research process. Most of the authors of the citation classics believed that their articles introduced a new theory or concept; 57% responded that their articles were published at the right moment; 70% noted that their work made an impact on both academia and practice; and 66% continued to work on the same topic after publishing the article. Serenko and Dumay (2017) concluded that while serendipity found to have played an important role in discovering new phenomena, especially for

developing the foundation for KM as a discipline, future research would require a more formal and structured inquiry.

Serenko and Dumay (2015a, 2015b, 2017) found growing trends in KM research. They noted the well-established notion that information technologies are drivers of organizational KM initiatives, and to "facilitate successful use of KM technologies, a positive knowledge-sharing culture is required" (Serenko & Dumay, 2015b, p. 1345). Knowledge sharing is one stage in the knowledge life cycle, and Nissen (2014) considered the knowledge lifecycle to include activities such as creating, organizing, formalizing, sharing, applying, and refining, as a dimension of his 5D knowledge-flow model. The act of knowledge sharing moves knowledge from an individual to small groups to departments to the entire organization and beyond, reaching a critical mass that can affect change. Knowledge sharing, although in the life-cycle dimension, greatly affects the reach dimension in Nissen's (2014) model. In this review of the literature, knowledge sharing is grouped under the reach dimension of knowledge flow subsection.

Knowledge-flow dynamics

Coradi, Heinzen, and Boutellier (2015) linked the need for an organization's continuous innovation and success to considerable research toward a general understanding of knowledge flows, knowledge sharing, and knowledge creation. With the shifting role of headquarters of multinational corporations (MNCs) in generating and distributing knowledge across their networks, Kumar (2013) recognized a dearth of research on the persistent underperforming reverse knowledge flow from subsidiaries to their respective headquarters, particularly from those in developing countries. Kumar asserted that emerging evidence of growing importance of reverse knowledge flow for

the MNCs existed, but very few researchers attempted to explain, theoretically or empirically, why such a phenomenon occurred. Kumar used a grounded-theory research method to generate a unifying theoretical framework based on two cases. First, the author identified the factors that affected reverse knowledge flow from subsidiaries located in developing countries. Kumar then proposed a managerial attention-based view for effective knowledge transfer in MNC networks. Two European MNCs established that subsidiaries provided a potential source of knowledge but neither the transfer mechanism nor motivation to transfer existed in these two cases. An integrated review of existing literature bolstered the theory-building narrative.

Kumar's (2013) review aimed to identify factors affecting reverse knowledge flow and to categorize managerial attention perspectives on effective knowledge transfer. Researchers collected no data to build discussions specifically. Rather, they based their theory building on the existing body of literature on these two KM research streams and used the two cases as backdrop. Kumar (2013) found managerial attention to be a prerequisite for knowledge transfer and was a key factor in recognizing a potential source of knowledge in multinational networks. Further, five factors were responsible for reverse knowledge flow—perceived value of knowledge, knowledge source awareness/attractiveness, location specific effects, sociocultural and institutional distance, and strategic importance of subsidiary—and six managerial attention types—relative, supportive, knowledge-seeking, explicit, tacit, and sustained—needed to promote reverse knowledge flow. Kumar revealed MNCs were inefficient in exploiting knowledge from distant subsidiaries, especially those located in developing countries.

Researchers developed models to describe and visualize the phenomenon of knowledge-flow dynamics. One of the earliest models, Nonaka's (1994) two-dimensional model, consisted of epistemological and ontological dimensions. Nonaka described knowledge flow as a spiral pattern through an organization with repeating patterns of interacting tacit and explicit knowledge. Nonaka referenced the explicitness dimension as epistemological. Nonaka, Toyama, and Konno (2000) later extended this reference into four knowledge-flow processes—socialization, externalization, combination, and internalization (SECI)—to granularize the tacit and explicit knowledge conversion. The epistemological dimension pertained to the uniqueness of knowledge itself, whereas the ontological dimension characterized the level of social aggregation from individual to group to organization.

Nissen (2002) extended Nonaka's (1994) two-dimensional model into a four-dimensional knowledge-flow model, referencing Nonaka's epistemological dimension as explicitness and Nonaka's ontological dimension as reach. Next, Nissen (2002) added two complementary dimensions: life cycle and flow time. Life cycle represents activities associated with knowledge flow such as knowledge creation, sharing, and application. Flow time refers to the time needed for knowledge to move from one person, organization, place, or time to another. Nissen (2014) further augmented this four-dimensional model with the knowledge-power dimension by defining knowledge power as "the capacity of harnessing dynamic knowledge for competitive advantage" (p. 254). This 5D model is the result of more than 2 decades of research and development, continuously building on previous work. Nissen (2002) introduced gradation to Nonaka's (1994) well-established binary states of tacit and explicit knowledge by defining the two

states through a tacit-explicit continuum. Nissen (2002) connected organizational performance and workflow processes (also described in Georgakopoulos, Hornick, & Sheth, 1995), stating that knowledge flows along the critical path of workflows and hence aligns with organizational performance. Nissen's (2014) 5D knowledge-flow model allowed visualization of the nature of the four knowledge-flow processes (socialization, externalization, combination, and internalization), tacit versus explicit knowledge, and the associated power across levels over time, from individual to group to organization and the reverse. Nissen's development of the fifth dimension of knowledge power allowed other researchers to measure dynamic knowledge flow (Nissen, 2014). Based on this 5D knowledge-flow model, Nissen (2014) postulated five principles to better understand the dynamics of knowledge flow.

The first principle relates to the innate inertia of knowledge. Knowledge at rest remains at rest and knowledge in motion stays in motion, not unlike Newtonian physics. In the context of organizational knowledge flow, if a person or organization desires knowledge flow, an actor must take some action to induce the flow, such as through formal or on-the-job training. However, if a person or organization requires restricted knowledge flow, an actor must take some action to limit the flow.

The second principle addresses the interactions between knowledge flows and organizational-workflow processes. The second principle states that experiential processes (the doing) contribute to workflow processes, and educational processes (the learning) contribute to knowledge flows. It follows that if the aim is to promote knowledge flows, it is important to understand how the specific knowledge flows relate

to organizational workflows; thus, changes to workflows would require changes to knowledge flows, and vice versa.

The third principle furthers the concept of the relationship between knowledge flows and workflows. Workflows represent organizational processes. Knowledge-based actions or activities are associated with organizational processes that are responsible for the knowledge-flow phenomena. Therefore, knowledge flows should always lie along critical paths of workflows to enhance organizational performance.

The fourth principle brings in the temporal dimension and states that knowledge flows and workflows operate on different time horizons; therefore, most knowledge flows must complete their course before critical and dependent workflows can begin. The fifth knowledge-flow principle encapsulates the concept of knowledge power: explicit knowledge flows quickly and broadly but with relatively diluted power, whereas tacit knowledge flows comparatively slowly and narrowly but with higher power. Of these five principles, research mostly focused on the first four principles. Work on the fifth principle is still in its infancy. The following subsections discuss the state of research in the five dimensions of the knowledge-flow dynamics: reach, explicitness, life cycle, time, and power.

Reach Dimension of Knowledge Flow

Knowledge sharing is the process enabler for knowledge to flow across individuals, organizations, and geographical locations. In the 49th Hawaii International Conference on System Sciences, researchers introduced a new mini-track, entitled Knowledge Society/Knowledge Sharing and Utilization in International/Global Setting, signifying a broadening body of knowledge that reaches beyond sharing among

individuals, toward the exploration of transforming knowledge into action in the global context (Jennex & Croasdell, 2016). The culture of reciprocity played a more prominent role in collaborative work through knowledge sharing than the use of information systems (Dittes & Smolnik, 2016). However, Serenko and Bontis (2016) found the reciprocal mode of exchange had no apparent effect on knowledge-sharing attitude among exchange modes such as reciprocating, negotiating, and cooperating. Leaders create the culture of learning through deliberate learning or knowledge sharing in a project (Ayas & Zeniuk, 2001). Cavaliere and Lombardi (2015) explored organizational culture in knowledge sharing from the perspective of subsidiaries of MNCs and found top-management support or leadership to be critical in facilitating interpersonal relationships to enhance knowledge sharing. Zqikael, Levin, and Rad (2008) collected data from 275 projects in Israel and proposed a self-assessment model that recognized the organizational knowledge-management system as one factor to strengthen top-management support toward project success.

Kim et al. (2013) realized managers had difficulty effectively supporting inter- and intraorganizational knowledge sharing and creation without better understanding how and where knowledge flowed or stopped among organizational members and across units. To avoid knowledge inertia, researchers leveraged social-network analysis to develop a form of knowledge-flow network maps as a tool for managers to gain such understanding. Using a comparative-case-study methodology based on six cases, they explored the existence and patterns of various organizational-knowledge paths in six industries. Six participating organizations provided 2,208 participants for the study and contributed between 115 and 456 business people from each organization at five

management levels: employee, assistant manager, manager, associate general manager, and general manager.

Kim et al. (2013) conducted the network survey over a 1-year period with an 81.3% response rate. The three steps in the analysis included within-case and cross-case scenarios. Kim et al. (a) identified the knowledge-flow paths using a social network-analysis tool, NetMiner 3, developed by the authors to establish the knowledge-flow network of participating organizations; (b) examined the general structure and features of each organization's knowledge-flow network and the role-specific node features of knowledge owner, knowledge provider, and knowledge broker; and (c) analyzed each organization's knowledge-flow patterns and suggested measures to remove bottlenecks in the knowledge network. They found that the within-unit knowledge flows were more dominant over the inter-unit ones, with the downward knowledge flows more dominant over the lateral and upward knowledge flows suggesting managers should facilitate more bottom-up knowledge flow. Distributions of knowledge owners and providers tended toward an L-shape and the gap between knowledge owing and providing widened as one went up management levels. In fact, knowledge owing and providing concentrated mostly at the top 20%, leading to knowledge hoarding. This top 20% of an organization dominated 72% of the knowledge-brokerage activities, suggesting it was crucial to identify the top 20% to provide them with knowledge-brokering support.

Managers should have a solid understanding of knowledge flows and the associated knowledge nodes to facilitate maximum knowledge transfer (Kim et al., 2013). Social network analysis in the form of knowledge-flow network maps described in this study could provide a tool for managers to gain such understanding. Kim et al. (2013)

suggested that future work focus on measuring the actual knowledge flows and consider the types of knowledge. Future researchers could also replicate their research protocol for other empirical study on KM strategies in other contexts and countries.

C. Lin et al. (2013) took another direction to avoid inertia and proposed a triangulation research approach studying determinants of knowledge flows through visualization to allow managers to take actions toward more effective and efficient KM. The triangulation approach employed a mix of qualitative and quantitative methodologies. The researchers implemented three research methods in the study: content analysis, survey, and formal concept analysis (FCA). The research design included five steps: (a) produce the conceptual structure of determinants of knowledge flows based on content analysis (using a single pilot case) and FCA (using multiple cases), (b) reveal the relationships among determinants to knowledge flow using FCA, (c) conduct a survey to expand the sample size to validate findings, (d) perform reliability and validity analyses, and (e) interpret the findings.

C. Lin et al. (2013) collected data from 12 companies in Taiwan that had KM initiatives. Data collection spanned 10 months and consisted of pilot and in-depth face-to-face interviews. To strengthen the qualitative analysis, they conducted a survey to expand the sample size with findings analyzed quantitatively. They examined (a) human behavior and knowledge characteristics, (b) organization intervention, and (c) IT use. Results showed that determinants of knowledge flows had intercausal relationships, and by understanding these relationships, one could enhance knowledge flow (C. Lin et al., 2013).

Zhang and Jiang (2015) asked with whom one should share knowledge, based on the knowledge recipient's perspective, and found that recipients' educational mindset affected the extent of knowledge sharing by the knowledge sharer. With an eye toward affective commitment in knowledge sharing, researchers conducted studies focusing on single factors such as motivation (S. Lin & Lo, 2015; Stenius, Hankonen, Ravaja, & Haukkala, 2016), generosity (Anand & Walsh, 2016), ignorance (Israilidis, Siachou, Cooke, & Lock, 2015), trust (Rutten, Blaas-Franken, & Martin, 2016), hoarding (Holten, Hancock, Persson, Hansen, & Hogh, 2016), rewards (Martin-Perez & Martin-Cruz, 2015), and psychological ownership (Li, Yuan, Ning, & Li-Ying, 2015).

Other researchers took a more holistic approach toward typology for impactful knowledge sharing. Mahmood, Qureshi, and Evans (2015) identified nine categories of deterrents to intra- and interorganizational knowledge sharing: the high cost of sharing knowledge, limitations in IT, knowledge hiding, lack of socialization, lack of trust culture, noneducational mindset, organizational politics, poor leadership, and time pressure. The researchers studied these categories as individual constructs. Coradi et al. (2015) synthesized categories of deterrents and devised a colocation scheme to encourage more spontaneous face-to-face cross-functional knowledge sharing toward organizational innovation and success. S. Lin and Lo (2015) developed a theoretical model using two mechanisms—calculative-based and relational-based—to explain motivation mechanisms in knowledge sharing. The resulting social-exchange theory resonated with the concept of organizational politics, knowledge hiding, and lack of trust culture in the knowledge-sharing typology espoused by Mahmood et al.

Explicitness Dimension of Knowledge Flow

Klafke, Helmann, Picinin, de Francisco, and Pilatti (2016) studied the practices of converting tacit knowledge into explicit knowledge in Brazil, Russia, India, and China (BRIC) industries. The researchers examined papers on KM practices in BRIC industries collected by the Scopus database. They found that, of the four BRIC countries, China had the most difficulty converting tacit knowledge into explicit knowledge. Meanwhile, Brazil, Russia, and India adopted similar KM practices such as the use of technology, standard operation procedures, and electronic data management. China converted tacit knowledge into explicit knowledge through interpersonal relationships. The Klafke et al. work provides important insights for managers and workers to perform better in these countries.

Kaiser et al. (2014) dynamically captured the process of converting tacit knowledge to explicit knowledge by employing an abductive framework to create and discover knowledge about needs, which they viewed as "the most valuable knowledge for organizations as well as for individuals" (p. 3499). They used a grounded-theory research approach to three-step iterative data analysis and framework development to create a catalog of substantial needs of Austrian bakers: data acquisition, hypotheses generation, and hypotheses validation. The researchers used the data-acquisition step to create Nonaka et al.'s (2000) "ba," a shared space for knowledge creation that enabled learning from the future. Learning from the future meant "to sense, tune in, and act from one's highest future potential" (Kaiser et al., 2014, p. 3503) with relevance for all stakeholders.

Accordingly, for their study on bakers' needs, Kaiser et al. (2014) learned the future from the customers' point of view, the employees' point of view, and the bakers'

point of view. To create the *ba,* Kaiser et al. conducted five identical workshops in different Austrian regions attended by 120 bakers. Each participant role-played all four identified stakeholders in the Austrian bakers industry: customers, owners or chiefs of bakeries, employees of bakeries, and the Austrian Federal Economic Chamber. Each workshop lasted 3 hours and included a 20-minute break. Each workshop had four segments addressing each of the stakeholder group's needs in 2-years time. The data-acquisition step generated a set of satisfiers believed to satisfy the future needs of all four stakeholders.

The set of satisfiers became the input to the second step to generate a set of hypotheses about substantial needs of the stakeholders (Kaiser et al., 2014). Following the grounded-theory methodology, the authors generated 591 codes that reduced to 441 codes in a second coding cycle, resulting in 12 hypotheses about needs. They used memoing with initial thoughts and drafted codes to identify emerging concepts. The researchers validated the hypotheses using qualitative and quantitative methods to obtain explicit knowledge about substantial needs of the four stakeholders of the Austrian bakers. Kaiser et al. focused on reporting the empirical findings of the first step of their framework, as the project took place. They detected and generated need knowledge in a short time frame.

Holford (2016) argued that not all tacit knowledge could be fully converted into explicit knowledge, especially collective tacit knowledge found in communities of practices. Further, management should contextualize knowledge such as routines, procedures, and expert systems and factor in human expertise, experience, and decision making. Bartolacci, Cristalli, Isidori, and Niccolini (2016) applied the Nonaka et al.

(2000) SECI model to create a virtual *ba;* an environment to connect people from different organizations in a web platform for knowledge creation. Bartolacci et al. effectively demonstrated tacit-to-explicit knowledge conversion on a virtual platform using a case called Business Innovation in Virtual Enterprise Environments in Europe. In fact, this case successfully replicated all four SECI knowledge-creation processes at the interorganizational level. The authors suggested the SECI spiral should consider interorganizations as part of the ontological dimension; an element inferred in the reach dimension of Nissen's (2014) 5D knowledge-flow model.

Life-cycle Dimension of Knowledge Flow

Nissen's knowledge-flow model (2002, 2014) described the cyclical flow of knowledge creation, distribution, and application life cycle by an individual, a group, or across an organization. McIver and Wang (2016) proposed a knowledge-in-practice framework as a scale to measure types of knowledge characteristics in organizations. Theoretically, the approach could point to the different phases of the knowledge life cycle to determine the underlying knowledge needed for different types of work. Kianto, Vanhala, and Heilmann (2016) built a theoretical model to explore job satisfaction through the knowledge life cycle and noted that intraorganizational knowledge was key to job satisfaction. Hafner (2016) restarted the knowledge flow life cycle through unlearning of old competencies to learn new ones in maintaining quality and safe healthcare. Kaiser (2017) proposed a paradigm to learn from the past and the future to enhance learning.

Time Dimension of Knowledge Flow

Limited work on knowledge flows focused on time dimension. Considering vertical-knowledge processes as knowledge flows and horizontal processes as workflows, work by Pourzolfaghar et al. (2013) supported Nissen's (2002, 2006b) theory on the interactions between knowledge flow and organizational-workflow processes and indicated that companies should manage knowledge flows like workflows. The researchers used the case-study research protocol described by Yin (2003) to explore a framework to enhance knowledge flow between two sets of experts during the architectural conceptual-design phase of a green-building project, thereby bringing the time dimension into the discussion. The authors matched the observed mechanical and electrical knowledge communicated with the Macmillan et al. (2001) framework definitions for architectural-design activities during the conceptual-design phase. Following Yin's (2003) validation approach, they compared the data to Burberry's (1997) mechanical/electrical standards, and the Malaysian green-building standards (MS1525, 2007). The collected data showed 95% agreement in both areas.

Pourzolfaghar et al. (2013) performed no further statistical analysis of the findings. Rather, they formulated a two-dimensional matrix to analyze required mechanical and electrical knowledge and the step in the conceptual-design phase, when this knowledge mattered most. They intended the matrix to clarify knowledge needs during the conceptual-design phase through the pattern-matching technique. They found that some Macmillan et al. (2001) framework activities possessed two-directional knowledge flows (knowledge needed by mechanical and by electrical experts) and others possessed one-directional knowledge flow (to or from architects or mechanical/electrical

engineers). The Pourzolfaghar et al. work contributed to merging the foundation of KM with an architectural-design framework, yielding a richer canvas and place for KM in realms beyond information systems. The study demonstrated the linkages between knowledge flow and workflows and the importance of the multidimensional knowledge flows necessary for high-performing organizations.

Power Dimension of Knowledge Flow

Knowledge power depends much on the effectiveness of knowledge flows. Nissen (2014) proposed five principles of knowledge power development: (a) knowledge enables organizational competitive advantage; (b) knowledge flows unevenly and therefore must flow for organizational performance; (c) tacit knowledge is more valuable than explicit knowledge for competitive advantage; (d) knowledge flows should balance learning with doing; and (e) people, processes, organizations, and technologies should work together to enhance knowledge flows. Goh and Ryan (2008) selected 16 learning companies and their corresponding 27 direct competitors across nine industry sectors classified by *Business Week.* The authors compared the market and accounting performances of these 43 companies to determine the relationship between knowledge and competitive advantage. They established a strong positive link between knowledge and competitive advantage. However, they highlighted that the study could not determine whether learning capability alone determined high performance.

Jugdev (2007) examined the source of organizational competitive advantage from the view of explicit and tacit knowledge-sharing practices based on Nonaka's knowledge-sharing spiral (SECI model). Jugdev conducted a multivariate exploratory study using project management as the intangible asset: the source of organizational competitive

advantage. The author invited 2,000 randomly selected participants to participate in a survey and 202 completed the survey yielding a 10.1% response rate. The findings showed significant correlations between all four knowledge-conversion processes of SECI. Tacit knowledge in project management had the potential to be the source of organizational competitive advantage.

Ultimately, knowledge power hinges on whether a company adopts an innovation, for example. Ingram and Morisse (2016) studied Bitcoin entrepreneurs in building legitimacy of new communities across borders. Inouye (2016) explored country-level militarization as an entrepreneurial innovation and built an innovation framework as a context for militarization. Inouye found a significant negative relationship between the new technology ventures and the militarization context.

Kaiser (2017) defined vision as an "image of a fulfilling and desirable future" (p. 4496). He noted that while visions had long been accepted to have critical impact on organizational performance, group effectiveness and growth in entrepreneurial environment, the literature lacked theoretical foundations for vision development and the vision-development process. Kaiser (2017) introduced the theory wave for the development of sustainable visions. He differentiated sustainable visions as those that addressed current as well as future human needs, and further postulated that sustainable visions encompass two aspects: long-term action guiding and noncompromising for others to meet their needs and desires. Vision development is essentially a knowledge-based action. Attaining a vision is therefore associated directly with high knowledge power.

Kaiser (2017) adopted the case study methodology to build the theory on sustainable vision development. Based on two very different cases, Kaiser derived three common features for developing sustainable visions: (a) learning from an envisioned future; (b) need orientation; and (c) a knowledge-based wavelike process with both top-down and bottom-up approaches. The knowledge-based wavelike process provides three steps to deliver three knowledge-based outputs. The first step, the upward wave, provides the platform for explicit satisfiers or knowledge on dreams, wishes, and ideas. The second step, the downward wave, is for developing sustainable vision by crystalizing the explicit satisfiers from the first step into substantial needs. The third step, upward wave again, is to implement the sustainable vision. Kaiser further argued that the third step enabled practical wisdom or phronesis to surface and therefore ensuring sustainable visions. Kaiser concluded that future work should include testing the theory wave on additional cases of different scopes and deriving concrete methods for vision development processes based on the theory wave.

Nguyen and Kohda (2017) furthered the concept of wisdom by anchoring their research on addressing how wisdom had been defined in the audit profession and thus elevated a traditionally knowledge-based audit process to a wisdom-based one. They used the case study methodology to collect data from a large public accounting firm in Vietnam. Data included interviews, observations, and documentation. They found that wise decision-making in the audit profession required the integration of three virtues: epistemic, enabling, and ethical. According to Nguyen and Kohda, epistemic virtue pertains to auditors' audit-specific expert knowledge such as (a) general knowledge of the accounting and auditing including generally accepted accounting principles (GAAP),

generally accepted auditing standards (GAAS), and flow of transactions; (b) technical knowledge of some functional areas such as use of computer-assisted techniques, testing procedures, or taxes; and (c) a subspecialty knowledge relating to an industry, sector, or specific client. Nguyen and Kohda noted that rarely an individual auditor possesses all three of these aspects.

In addition to audit-specific expert knowledge, Nguyen and Kohda (2017) found that auditors execute their tasks by exercising professional judgement. The authors argued that while all three aspects of the auditor's knowledge—general, technical, and subspecialty—are required during the synthesizing phase of an audit engagement, professional judgement of the partners and senior managers of the audit team are key to high-quality audit opinion. Nguyen and Kohda referenced the professional judgement as the enabling virtue. The third virtue or the ethical virtue, in the form of code of conduct and professional conduct, provides audit skepticism and reliability. Nguyen and Kohda postulated that these three virtues (3-E) together form the interdependent and interacting 3-E model of wisdom determinants for wise decision-making in the audit profession. This wisdom-based consideration relates directly to the power dimension of the knowledge flow.

ERP Implementation

ERP systems are highly complex and costly endeavors with implementation failure rates exceeding 50% (Nour & Mouakket, 2011). Failure rates could be as high as 85% in the public sector (Gauld, 2007). A substantial body of literature on CSFs for ERP implementation aims to better understand and enhance the implementation-success rate.

Critical Success Factors for ERP Implementation

Fotini et al. (2008) conducted a review of the literature on CSFs for ERP implementation to identify the business value of these systems. Dezdar and Sulaiman (2009) developed a taxonomy of CSFs for ERP implementation based on prevailing literature. Using the taxonomy framework, the researchers considered the ERP external environment—ERP software and ERP expertise—and the ERP internal environment—ERP user, ERP adopting organization, and the ERP project—to be critical in contributing to ERP-implementation success (Fotini et al., 2008).

Hanafizadeh, Gholami, Dadbin, and Standage (2010) extracted a core set of CSFs based on 62 published works of literature to develop a conceptual model for ERP project managers. Ngai, Law, and Wat (2008) identified 18 CSFs with more than 80 subfactors from a literature review on ERP implementation across 10 countries/regions. These studies and others represent a decade-long inventory of a huge number of factors for successful ERP implementations. Researchers cited top-management support, training, and education as most critical for successful ERP implementation, all in the domain of KM. They echoed the assertion of Sedera and Gable (2010) that effective enterprise system-related KM could result in high levels of implementation success. Tarhini, Ammar, Tarhini, and Masa'deh (2015) specifically considered CSF of ERP implementation from the stakeholders' perspective. The researchers of these studies underscored the concept that, because of the complexities of ERP projects, with their multiple stakeholders and varieties of need knowledge, ERP projects provide a fertile laboratory to study the intricacies of KM in general and the multidimensionality of knowledge flow in particular.

Liu (2011) built on four research streams—ERP, ERP KM, CSF for ERP KM implementation, and management performance—to study the influence of CSF of ERP KM on management performance in the Taiwanese high-technology industry. Liu developed a close-ended questionnaire to collect data. Liu then performed statistical analysis using SPSS 10.0 for Windows based on four CSF constructs to validate three sets of hypotheses: support from senior managers and corporate visions, reengineering and project management, appropriate consultants and software suppliers, and proper employee and education training.

Liu (2011) assessed the relationship between ERP KM and management performance, the relationship between CSF and management performance, and the relationship between industry/corporate status and management performance and established hypotheses. Liu sent 630 questionnaires to six high-technology sectors in Taiwan and received 101 questionnaires with an effective recovery rate of 16.03%. KM, ERP system, ERP KM, CSFs for introductions, and CSFs for management performances possessed reliability values of 0.792, 0.781, 0.763, 0.775, and 0.735, respectively, suggesting good reliability; the measurements showed good internal consistency. All the CSFs showed positive influences on management performance: support from senior managers, corporate vision, reengineering of corporate flows and project management, selection of appropriate consulting firms and software suppliers, the identification of suitable employees to take part in the ERP introduction, and the proper training and education programs. In the multiple regression analysis, all individual constructs positively and significantly correlated. Individual variables showed a high degree of explanatory power.

Liu (2011) concluded that the introduction of ERP KM positively influenced management performance. The CSF derived to introduce ERP KM significantly and positively influenced management-performance improvement. Last, introducing ERP and KM together provided a significant boost, enhancing management performance and competitiveness.

Jeng and Dunk (2013) considered knowledge as a CSF, in the context of ERP postimplementation success. To determine ERP system success, the authors developed a conceptual model based on six KM enablers in three categories and their relationships to the SECI knowledge-creation processes. The researchers chose culture (collaboration, trust, and learning), structure (decentralization and low formalization), and information-technology support as KM enablers. The authors selected 28 major footwear and apparel manufacturers from North America and South America for the study and performed statistical analysis on the resulting 187 usable responses. The researchers demonstrated that ERP operational success critically depended on KM enablers. Furthermore, ERP success depended on the interplay between knowledge creation and organizational culture, structure, and information-technology support in multiple aspects.

Knowledge Management in ERP Implementation

KM has long been part of the literature on ERP-system implementation. Early efforts included a KM-system design proposed by O'Leary (2002) to support the choosing, implementation, and use of ERP systems based on the premise "to connect those who know with those who need to know. To convert personal knowledge to organizational knowledge" (p. 101). O'Leary highlighted that KM systems could also be

developed to support other aspects of ERP systems such as designing, developing, maintaining, and testing.

In large part, researchers adopted KM as an enabler in ERP implementation. Inadequate knowledge sharing among implementation teams and other organizational members contributed to unsuccessful ERP implementation (Jones et al. 2006). In essence, Jones et al. (2006) recognized the dimension of multiple stakeholders in KM. The researchers introduced a conceptual research model to demonstrate a set of six organizational cultural dimensions to best facilitate knowledge sharing during ERP implementation.

Chan, Walker, and Mills (2009) used a single-case-study approach to assess the effectiveness of an ERP system from a KM perspective. They singled out one stakeholder group and introduced a knowledge-based evaluative framework for project managers. They aimed to facilitate an ERP-system deployment to effectively leverage KM to enhance an organization's winning position. Three infrastructures supported the framework: information-communication technology, leadership, and people. The research design, therefore, naturally incorporated triangulation to answer two research questions: (a) What are the drivers and barriers that can facilitate an ERP system to be effectively deployed to provide useful information that facilitates knowledge transfer about its cost-management effectiveness? and (b) At what level of capability maturity is the organization placed to support ERP tools? The organizational cost-management department acted as the unit of analysis, with a staff of about 200 employees and 50 potential respondents with ERP experience ranging from information and communications-technology staff to senior managers and operational staff.

Chan et al. (2009) approached 18 staff members who agreed to participate. The researchers conducted a survey that included areas such as respondents' perceptions and expectations of what ERP would deliver, efficiency of the system (mean at 1.22 on a 5-point scale and standard deviation at 0.43), performance, implementation problem, system effectiveness, impact of the ERP implementation on the organization's productivity, and suggestions for incorporating other ERP applications. The researchers found that effective ERP deployment depended greatly on human-to-human knowledge transfer. More importantly, Chan et al. extended the use of the ERP system as a KM instrument to help construction contractors manage project-control systems better by focusing on cost management.

Negi and Bansal (2013) took up the life-cycle dimension of KM and stated that existing requirements in engineering techniques did not completely capture configuration-specific information in an ERP implementation. The information gap between the information captured during the requirements engineering phase and the information needed for the configuration phase could lead to significant implementation cost and business failure. Pourzolfaghar et al. (2013) observed a similar occurrence in their work on knowledge flow between two sets of experts during the design phase of a building-construction project. Negi and Bansal adopted a solution called data activity model for configuration (DAMC) to minimize the knowledge gap. They used a quantitative method to validate whether DAMC would capture configuration-specific requirements. The research methodology leveraged knowledge-process modeling techniques based on three constructs—perceived usefulness (PU), perceived ease of use

(PEOU), and intention to use (IU)—to improve ERP implementation during the configuration phase.

Negi and Bansal (2013) developed the DAMC model based on sales-order activity and a corresponding questionnaire of 15 closed-ended questions, formulated with a 5-point Likert scale. They collected data in two parts, conducting unstructured interviews first, then introducing respondents to the DAMC model for their feedback. The 94 respondents previously experienced between less than 5 and 15 years of ERP-implementation experience, and held positions from ERP consultants to program managers and academicians. The researchers performed statistical data analysis to validate responses and found an overall positive correlation between the constructs PEOU, PU, and IU. A positive correlation emerged between PEOU and IU (.726) and between PU and IU (.819), with the higher correlation between constructs PU and IU, suggesting that dependence on the intention to use lay more on PU than on PEOU. Results of the one-tailed sample test with a significance level of 5% ($\alpha = .05$) allowed rejection of all null hypotheses. In sum, Negi and Bansal empirically demonstrated that participants perceived DAMC as an easy to employ, useful tool they intended to implement.

Other studies focused more on KM in the context of ERP implementation. Palanisamy (2008) examined the interplay of organizational culture and KM in ERP implementation. The researchers of this empirical study showed the influences of organizational culture on the four sets of knowledge processes in ERP implementation. Vandaie (2008) also looked at the role of organizational KM in ERP-implementation success, particularly on tacit and process-based ERP knowledge.

Remus (2012) cited poor KM as one factor in ERP-implementation failure, due to the multifaceted nature of knowledge sources in an ERP project. Remus attempted to explore the dynamic behavior of KM in ERP projects by adopting a systems-thinking perspective. Remus used an interpretive-case-study approach to identify the underlying cause and effect that led to KM challenges and how these affected the performance of key KM activities in ERP projects. Using the 100% New Zealand-owned and operated New Zealand Building Company as the unit of analysis, Remus used a mix of qualitative methods, administered in two stages, for data collection and analysis. The first stage identified the main challenges to KM activities through in-depth face-to-face interviews lasting between 1 and 2 hours, conducted over 2.5 months in the middle of the system's roll-out. Audiotaped and transcribed interviews yielded more than 250 pages of transcripts. For the second stage, Remus used a causal mapping methodology to explore the interactions and consequences for the case-study organization through multiple brainstorming sessions conducted over a 7-month period.

Remus (2012) discerned two implications from the study. First, this study, through causal mapping, showed the importance of uncovering interactions between barriers to effective KM to balance the allocation of resources between business priorities and IT needs. Second, systems thinking helped explain drifts in ERP projects. For the most part, researchers anchored their work in ERP implementation with KM playing a supporting role. Remus's work extended existing knowledge on KM challenges by showing the importance of revealing the dynamics behind how KM challenges unfolded over time.

Instead of leveraging KM to support ERP implementations, the complexities of ERP projects offer an ideal microcosm for the study of the KM phenomena. Wang et al. (2007) acknowledged that ERP projects possess knowledge-intensive qualities that require multiple stakeholders to interact extensively during the implementation. They focused their study on the knowledge-sharing factor, among the list of CSFs in ERP implementation, in the causal relationships between consultant competence and the absorptive capacity of the adopting organization toward the eventual organizational process fit of the ERP system.

Sharma, Daniel, and Gray (2012) defined absorptive capacity as an organization's ability to innovate, which depends on its ability to recognize the value of new knowledge and to assimilate and augment existing knowledge to sustain and develop the organization. Sharma et al. noted absorptive capacity factored heavily in effective ERP implementation and explored individual and organizational contributions to knowledge processes and their interactions in absorptive-capacity development. They chose nine cases in India for their study and concluded that firms lacking knowledge of ERP implementation could not simply seek this from external sources but needed to develop internal organizational knowledge processes to achieve effective system implementations. The Sharma et al. study highlighted the specificity of KM challenges in developing countries, where low levels of expertise greatly impacted the development of absorptive capacity.

ERP implementation in the Public Sector or in Developing Countries

ERP implementation faces additional challenges in developing countries that cannot readily adopt Western-developed information systems (Dezdar & Sulaiman, 2009;

Kanthawongs & Kanthawongs, 2011; Khattak et al., 2013). The particularities of the public sector also create a void for studies of ERP projects in government agencies, as implementation conditions of public and private sectors differ, suggesting that reasons for ERP systems may also differ (Alves & Matos, 2013; Lawson-Body, Willoughby, Mukankusi, & Logossah, 2011). Ward (2006) examined perspectives of top executives from the U.S. federal government and Fortune 1,000 corporations on different IS technologies. Although no significant differences emerged in the rank ordering of information-resource management between public and private sectors, minimal empirical research compared and contrasted public and private-sector management of IS technologies (Ward, 2006).

Alves and Matos (2013) considered the reasons and motivations for the implementation of ERP systems in the public sector and expanded the theory on ERP adoption. They conducted an online survey of a population of 130 organizations that successfully implemented an ERP system. They used a test-pilot case to validate the questionnaire using a panel of five experts. The accountant acted as the key informant from each of the 130 organizations. The researchers aimed to examine the relationship between accounting and an ERP system in the postimplementation phase. Next, they analyzed data collected using the SPSS statistical package. Of the 130 organizations queried, 66 completed the questionnaire, forming a response rate of 51%. Respondents indicated that integration of applications was the most important reason (86%) to adopt ERP systems, followed by increased demand for real-time information (82%), and finally, the information generation needed for decision-making (77%; Alves & Matos,

2013). The researchers used a contingency table, ANOVA *F* test, and Pearson chi-square test to analyze the association between public and private organizations.

Alves and Matos (2013) found no significant difference between public and private organizations in adopting ERP systems. The organizations implemented the financial accounting module (94%) most often, followed by the materials management module (83%), and next, the controlling module (80%). Private organizations in the study implemented significantly more modules than the public organizations. Furthermore, public organizations implemented ERP between 3 and 9 years, whereas the majority of the private sector had been using ERP longer than 5 years. On average, the public sector had a shorter deployment time than the private sector. Alves and Matos presented several main motivators for the implementation of ERP systems: search for systems integration, increasing demand for real-time information, demand for information systems integration, need to generate information for decision making, and increased competitiveness in markets. The most implemented modules were financial accounting, materials management, and controlling.

The body of knowledge on ERP implementation in the public sector of developing countries is primarily of a descriptive nature and lacks generalizability. Floropoulos, Spathis, Halvatzis, and Tsipouridou (2010) measured the success of the taxation-information system in Greece based on an updated DeLone and McLean model of information-system success. Diamond and Khemani (2005) and Dener et al. (2011) collectively recorded almost 100 ERP implementations in the public sector of developing countries. Their discussions focused on components of the systems and their strategic position in the respective country's medium to long-term public-sector reform agenda.

Researchers of public-sector ERP implementations often draw from the experience of the private sector of developed countries. Lawson-Body et al. (2011) cited the lack of research on customer-relationship-management implementation in the public sector and attempted to identify a set of information-technology and customer-relationship-management implementation factors in the private sector best suited for customer-relationship-management implementation. Kamhawi (2007) focused on two success measurements—project success (project due dates, budgets, scope, and expected performance) and business success (inventory reduction, production-cycle-time reduction, and time-to-market reduction)—drawn from studies in developed countries as measures of ERP implementation success in Bahrain.

With the increased adoption of e-Government initiatives, Floropoulos et al. (2010) observed the lack of a theoretical model to effectively determine the success of e-Government initiatives. The authors developed an e-Government IS success model based on those by DeLone and McLean (2003) and Seddon (1997) to assess the Greek tax IS. The researchers were the first to quantitatively examine the success of such a complex system; tax evasion resulted from unfairly high taxes in Greece. The researchers expected the Greek tax IS would reduce the rate of tax evasion. They derived the study from the IS-success theory from the perspective of expert employees.

Floropoulos et al. (2010) developed a theoretical model with five constructs: information quality, system quality, service quality, perceived usefulness, and user satisfaction. They adapted the model of DeLone and McLean (2003) and Seddon (1997) to test four hypotheses: (a) higher levels of information quality positively relate to higher levels of perceived usefulness and higher levels of satisfaction when using the tax IS, (b)

higher levels of system quality positively relate to higher levels of perceived usefulness and higher levels of satisfaction when using the tax IS, (c) higher levels of service quality positively relate to higher levels of perceived usefulness and higher levels of satisfaction when using the tax IS, and (d) higher levels of perceived usefulness positively relate to higher levels of user satisfaction when using the tax IS. Taxation employees working in the departments of public economic agencies throughout Greece acted as the population for the study. The researchers based the questionnaire on relevant previous studies, and 10 employees pilot-tested the questionnaire to clarify ambiguous wordings. The researchers distributed the refined questionnaire to a randomly selected set of 900 employees. Overall, 340 employees responded, resulting in a 37.8% response rate. The researchers analyzed the variables related to the success of the Greek tax information system using principal component analysis with varimax rotation.

Floropoulos et al. (2010) showed that the five factors had more than 74% total variance, which they considered satisfactory. The Kaiser-Meyer-Olkin measure of sampling adequacy produced high results, suggesting factor analysis was appropriate for this data set. Cronbach-alpha reliability estimates ranged between .622 and .874, pointing to strong reliability for all constructs. All variables positively correlated with one another with correlations ranging between .204 and .529. Service quality and information quality (.529), user satisfaction and information quality (.499), and information quality and perceived usefulness (.454) at 1% significance level were the most important correlations. The authors concluded that strong connections existed between the five success constructs, which supported the hypothesized relationships, except for the relationship between system quality and user satisfaction. Taxation employees showed

greater concern with service and information quality. The effect of system quality on perceived usefulness was quite low and system-quality effect on user satisfaction was nonexistent. To enhance the success of the tax IS, the Greek authorities needed to provide higher service quality.

Kanthawongs and Kanthawongs (2011) asserted that because the West developed ERP packages, they might not fit the Asian context. They used an exploratory approach to identify factors and to validate proposed factors to develop a conceptual framework to study user satisfaction and cultural dimensions in ERP implementations in a developing country. The authors conducted interviews with 10 users from 10 organizations in Thailand that used ERP for their business processes. They identified four cultural dimensions—power distance, uncertainty avoidance, individualism/collectivism, and masculinity/femininity—as affecting user satisfaction in ERP-system implementation.

Khattak et al. (2013) conducted a narrative research study to empirically study CSF in ERP implementation in China. They first identified 20 CSF for ERP implementations based on an extensive literature review. Next, the authors developed a semistructured questionnaire using mostly closed-ended questions. They targeted 35 firms in China; 12 firms agreed to participate in the study. The initial questionnaire consisted of 70 questions and received pilot-testing. The final questionnaire consisted of 56 questions. The authors grouped the CSF into critical, least critical, and not critical, based on survey results. Khattak et al. compared the results from Chinese firms to the Pakistani data collected in a previous study conducted by the same authors. The two sets of enterprises regarded some factors similarly but others differently, pointing out that cultural differences likely had some degree of influence. This study aimed to consider

CSF in ERP implementation in developing countries based on CSF developed in Western countries. The findings demonstrated that different developing countries did not necessarily regard CSF at the same level of importance. This work further supported the concept that context matters in ERP implementation.

Summary

This review of the literature aimed to present the research trends in KM, focusing on knowledge flows, and to establish ERP implementation as an appropriate laboratory to study the multidimensionality of knowledge flow. The prevailing body of literature in knowledge-flow dynamics is descriptive in nature (Nissen, 2014), supporting Serenko and Dumay's (2015a, 2015b, 2017) conclusion that KM is maturing as a discipline and empirical studies will help the discipline progress. Studies on the multidimensionality of the knowledge-flow phenomena have been limited to only a couple of dimensions at a time, with the reach dimension garnering the greatest attention. This literature review also demonstrates that ERP implementation in the public sector and in developing countries offers a relatively untapped environment to study the uneven flow of knowledge using Nissen's (2014) 5D model.

Chapter 3

Methodology

This research was an explanatory single-case study (as described by Yin, 2014) to understand the phenomenon of knowledge-flow dynamics across stakeholder groups over a period of time in a real-life ERP implementation. Yin (2014) listed three considerations in choosing a research methodology: type of research question posed, extent of control an investigator has over actual behavioral events, and the degree of focus on contemporary rather than historical events. Case studies are the preferred approach when the research questions are in the form of *"how*" or "*why*," the investigator has no control over the actual events, and the focus is on contemporary phenomena. Yin (2014) put forth a two-part definition of the case-study research method that provides a framework for a research design directly linked to a data-collection strategy with an appropriate data-analysis approach. The first part stated the scope:

> A case study is an empirical inquiry that
>
> - investigates a contemporary phenomenon (the "case") in depth and within its real-world context, especially when
>
> - the boundaries between phenomenon and context may not be clearly evident. (Yin, 2014, p. 16)

The second part of the definition pertained to the features of a case study:

> A case study inquiry
>
> - copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result

- relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result
- benefits from the prior development of theoretical propositions to guide data collection and analysis. (Yin, 2014, p. 17)

Terrell (2015) added that a case study reports on an event that occurred to a particular person or group in a bounded system. The phenomenon of knowledge-flow dynamics under study is a bounded system that is not readily distinguishable from its context. The case-study research methodology was therefore the method of choice for this inquiry.

The remainder of this chapter adopts the structure for Chapter 3 of a qualitative research proposal presented in Terrell (2015). The following subheadings plus a summary describe the research design, instruments, sampling, and procedures, as well as plans for data analysis and presentation of results of the study. Ethical considerations of participants of the study were considered and addressed at appropriate junctures of this chapter.

Research Design

A case-study research design has five components (Yin, 2014): the study's questions, its propositions, its unit(s) of analysis, the logic linking the data to the propositions, and the criteria for interpreting the findings. Yin (2012) identified three steps in designing a case study:

1. Defining a case
2. Selecting one of the four types of case-study designs
3. Using theory in the study design

Defining a Case

The IFI-financed REPFMP was the study case. The core goal of REPFMP was to implement an ERP IS to support the finance ministry of the country's public financial-management processes that included budget planning, execution, and reporting. These budget-planning and treasury-IS are generally referenced as FMIS in the IFI and the broader development-aid communities. REPFMP was to have been the first FMIS implementation for the central government to enhance efficiency, governance, integrity, and transparency of public-resource management.

The 1997 financial crisis exposed a number of countries' entrenched socioecopolitical vulnerabilities and weak public financial management practices. In the ensuing years, the affected countries embarked on reforms aimed to overhaul their respective public financial-management institutions, processes, and systems. One reform initiative was the REPFMP, which one of the IFIs agreed to finance in 2003. REPFMP was to improve the government's public financial management, which in turn would contribute to better governance, thereby improving efficiency, governance, integrity, and transparency of public expenditure, and increase the potential for economic growth and poverty reduction. The case country and the IFI signed the loan agreement, valued at US$60 million, which included a US$5 million credit, in December 2004, with the implementation of an ERP IS specifically aimed at managing budget planning, execution, and reporting. The ERP piece comprised almost 85% of the entire loan as the centerpiece of the entire project. The REPFMP spanned 12 years starting in 2003, when the initial concept of the project took root. It officially closed on December 31, 2015 with the ERP system officially launched in April 2015.

Based on the experiences of 87 World Bank FMIS implementations over 25 years, 55 completed and 32 ongoing projects, Dener et al. (2011) found that total duration of completed projects was 7.9 years on average, ranging from 3.6 years in Afghanistan to 13.4 years in Malawi. Duration of the preparation (preloan signing) phase of the 87 implementations averaged 16 months, the effectiveness period (from loan signing to disbursement of loan fund) at 6 months, and the procurement of FMISs among completed projects took 2.2 years. Taken together, the average duration of preimplementation, from conception through the beginning of system implementation of World Bank-financed FMIS projects took about 4 years. The REPFMP took 5.5 years.

The preparation phase of World Bank-financed projects in general, including FMIS type projects, typically takes 18 to 24 months to progress from conception to the loan-signing stage. However, although the World Bank considers project implementation to commence after the signing of the loan agreements, the procurement stage remains to be conducted by the implementing countries, which can be a lengthy process, depending on the regulatory framework and capacity of the implementing countries. On average, the procurement stage alone can take up to 18 months (Dener et al., 2011). The REPFMP took 4.5 years.

Built into the loan effectiveness, the period between loan signing and fund disbursement that is common to IFI-financed projects, are conditions the government of the borrowing country must achieve. The effectiveness period for REPFMP took more than 9 months, a 3-month extension to the standard 6 months included in the loan agreement. The parties designed effectiveness conditions to ensure organizational readiness, adjusted to the specific country. One effectiveness condition for REPFMP was

the issuance of the bid document for the procurement of FMIS solutions. Given that system specifications were central to the bid document for the ERP system, one could consider the procurement of the ERP system to have started at loan signing in December 2004 and not when the project became effective in September 2005. Accordingly, the procurement phase of the ERP system took 4.5 years, starting with the signing of the REPFMP project loan between the government of the case study and the IFI in December 2004 and continuing to the signing of the ERP system-implementation contract between the government of the case study and the contractor in July 2009.

During the lengthy procurement period, doubts arose across the ranks in the finance ministry about whether such a comprehensive system was appropriate. For example, the prevalent human-resource base was not yet capable of supporting system acquisition, nor of using it once implemented. Also widespread concern arose about job security throughout the Directorate General of Treasury of the finance ministry, where the system was to be implemented. This hesitant sentiment could have led to project suspension and ERP system-implementation failure.

Over the life of the REPFMP, three presidents, six ministers of finance, and five IFI project managers were in office. The protracted procurement could be attributed to institutional memory drain and the general lack of capacity and capability of the human-resource base to support the ERP system-procurement and -implementation. A collective lack of knowledge, including the IFI teams, further exacerbated these deficiencies, particularly among those who were not decision makers at the lower echelons of the ministry about the vision of what the ERP system could do and the steps involved to achieve this future state.

The REPFMP case, with its intensive preimplementation period, dominated by a protracted but knowledge-rich procurement process, was the instrumental case in this study (aligned with Creswell, 2013) to illustrate the multidimensionality of the knowledge-flow phenomenon. The time period in the proposed case study was the 4.5 years from signing the loan between the government of the case study and the IFI in December 2004 through signing of the contract for ERP-system implementation between the government of the case study and the successful contractor in July 2009.

Selecting the Case-Study-Design Type

Following Yin's (2014) five components of case-study design, research questions and units of analysis played a major role in determining the case-study type. Given the context of the study (the case described above, the research questions defined below, and the unit of analysis explained further below under the subheading Participants and Sampling), the research employed an embedded, single-case study (as described by Yin, 2014) to address the following two research questions.

Research Questions

The research addressed two interrelated questions:

1. How can need knowledge and its flow across different stakeholders in an organization over time be explained using a multidimensional knowledge-flow model?
2. How can Nissen's (2014) 5D knowledge-flow model be validated using a real-life immersion case?

Theoretical Propositions in the Research Design

This researcher adopted Nissen's (2014) multidimensional knowledge-flow model as the theoretical framework to understand the multidimensionality of need knowledge flows across stakeholder groups of an ERP initiative. This study aims to explain why knowledge flows differently across stakeholders over time. At the outset, the research pointed to the notion that in understanding the multidimensionality of need knowledge flows across stakeholder groups of an ERP initiative, organizations would gain the operational links to better harness knowledge for their specific improvement initiatives and overall competitive advantage.

Nissen's 5D knowledge-flow model of 2014 was an amalgamation of decades of research and development. Nissen represented the five dimensions of knowledge-flow dynamics—reach, explicitness, life cycle, flow time, and power—by using a three-dimensional Cartesian coordinate system as a visual tool. The horizontal x-axis is the reach dimension that exemplifies the different levels of socialization from individual to group to organization. The vertical y-axis represents the explicitness dimension as it evolves from tacit to explicit. These reach and explicitness dimensions were adopted from Nonaka's (1994) ontological and epistemological two-dimensional knowledge-flow structure. The z-axis that comes out of the page symbolizes the life-cycle dimension progressing from knowledge creation to organizing, formalizing, sharing, applying, and refining.

The fourth dimension is the flow-time dimension denoted by an arrowed vector or line graph that connects the relationships and contextualizes the interplay among the three dimensions represented by the x-, y-, and z-axes. The flow-time dimension enriches the

reach, explicitness, and life-cycle dimensions with magnitude and direction of dynamic knowledge motion. This fourth dimension captures the amount of time required for knowledge to flow between coordinates, from individuals to organizations or points in space or time. The thickness of the arrowed vectors depicts the magnitude of the flow-time dimension: fast flows with thick vectors and slow flows with thin vectors.

The fifth dimension, knowledge power, is not captured in the coordinate system, but implicit as the concept of harnessing knowledge for competitive advantage, once the values of the other four dimensions are identified. The first four dimensions symbolize a particular knowledge flow. The knowledge-power dimension explicates the efficacy in achieving a knowledge-based action. Nissen (2014) argued that explicit knowledge flows comparatively quickly and broadly but its knowledge power is diluted or lacking in competitive advantage. However, tacit knowledge flows comparatively slowly and narrowly but with high knowledge power over time yielding competitive advantage.

Nour and Mouakket's (2011) framework of critical success factors for ERP implementation and Kaiser et al.'s (2014) rendering of the concept of need knowledge flow to relevant stakeholders at optimal times enhanced Nissen's (2014) 5D knowledge-flow model (see Figure 2). Nour and Mouakket's framework reinforces Nissen's (2014) knowledge-flow model as it considers the roles played by different stakeholders of an ERP project during the phases of the project life cycle. Kaiser et al. refined knowledge as a need to sustain an individual and an organization, echoing Nissen's (2014) knowledge-power dimension.

Instruments

Yin (2012, 2014) cited six sources of evidence most commonly used in case-study research: direct observations, open-ended interviews, archival records, documentation, participant or direct observations, and physical artifacts. This study adopted open-ended interviews as one source of evidence to provide the insiders' or emic view of events. Other sources of evidence included project-related documentation (e.g., semiannual progress reports, a midterm evaluation, and monitoring mission reports) and archival records (e.g., e-mails, formal correspondence, legal documents, and minutes of meetings) collected in the IFI's online depository of project-related documentation and archival records for the REPFMP. These materials were used to triangulate findings to provide the outsider's or etic view of events. Converging or triangulating data from at least three sources adds to the robustness and overall validity of a study (Terrell, 2015; Yin, 2014).

The study period was the 4.5 years of the preimplemenation phase of REPFMP from project loan signing in December 2004 to contract award in July 2009, as described above, focusing on flows of knowledge related to the procurement of the ERP system, the implementation of the system being the core of the country's public financial-management reform. The IFI maintains an online depository of project-related documentation and archival records covering the entire life of the project and beyond. As part of the standard operating procedure, the IFI project team filed project-related e-mails.

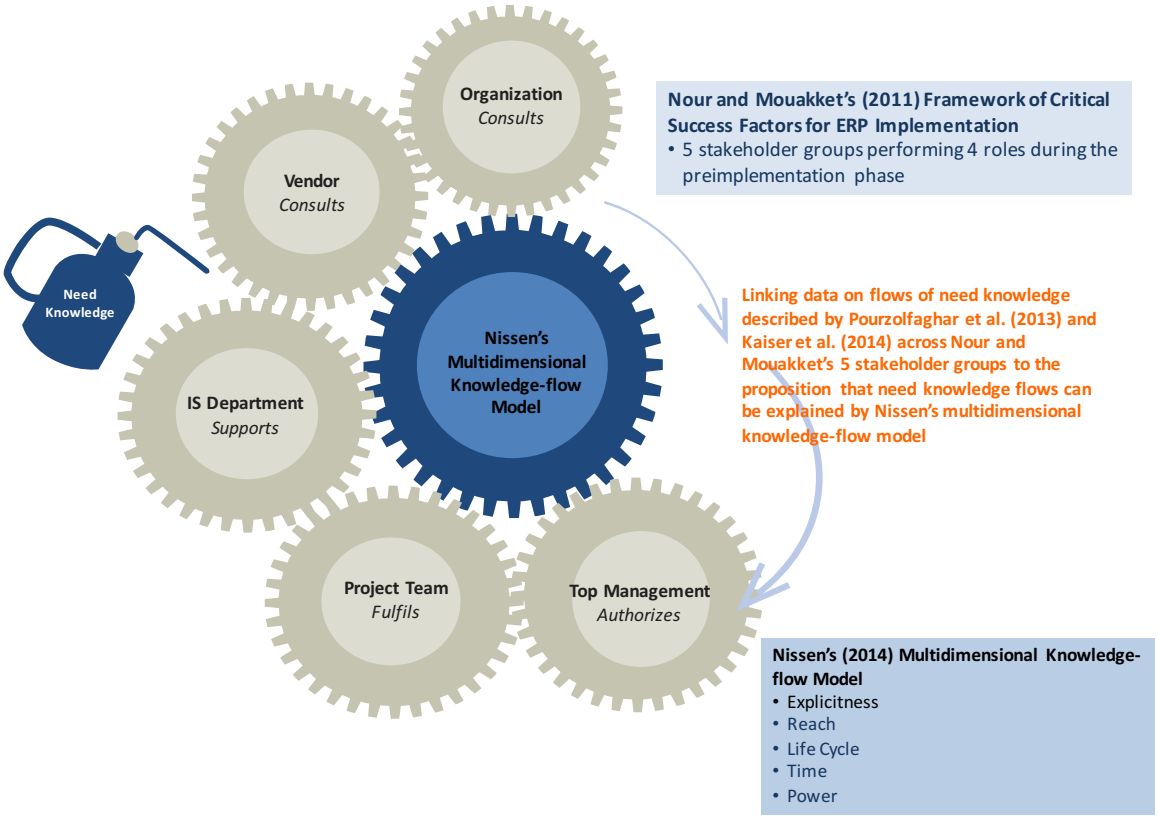

Figure 2. Framework to link data to theoretical propositions

The government of this case study produced semiannual progress reports of the project, as required, starting in 2016, including a midterm evaluation submitted in July 2009. In addition, the IFI conducted monitoring missions once every 6 months or so that resulted in findings and recommendations. The monitoring missions were contemporary analyses based on interviews with stakeholders of the REPFMP. The IFI project team and mission members outside the core project team conducted these interviews to lend objectivity. The resulting documentation captured the knowledge flow's explicitness, reach, life cycle, and flow-time dimensions.

The knowledge-power dimension depends greatly on how the knowledge was used, validated by archival records in the online depository as well as open-ended interviews conducted under the present research. The researcher gathered and studied

archival records such as e-mails, formal correspondence, legal documents, and minutes of meetings for the study period to filter for contents related to the procurement of the ERP system. An interview protocol described by Creswell (2013) was used to collect data from participants involved in the REPFMP during the ERP preimplementation stage of the project, provided in Appendix A. These probing questions were designed to address the research questions and to serve as a mental framework to conduct multiple lines of inquiry, similar to what a detective, journalist, or clinician would carry out (Yin, 2014). Discussions on the selection of participants, details of the research procedures, and data-analysis strategy are described in the following sections, respectively.

Participants and Sampling

As a current staff member of the IFI and part of the IFI's project team assigned to the REPFMP project from 2005 to 2007, the researcher had access to project-related documentation; specifically, semiannual progress reports, midterm evaluation, and monitoring mission reports, as well as internal archival records (e-mails, formal correspondence, legal documents, and minutes of meetings). Participants interviewed provided the emic perspective. Participants were from the IFI and the finance ministry of the country of this case study who were involved in the REPFMP from December 2004 when the project loan was signed between the case country and the IFI, to July 2009 when the ERP-implementation contract was signed between the case country and the contractor. Due to the involvement of human participants through interviews, the Institutional Review Board (IRB) process was required before any interviews were conducted. The IRB memorandum of approval is in Appendix B.

Unit of Analysis

Nour and Mouakket (2011) proposed a framework of critical-success factors for ERP implementation in three dimensions: six fundamental stakeholders (end users, top management, information-systems department, project team, organization, and vendor), three major phases of an ERP project life cycle (preimplementation, main implementation, and postimplementation), and five different roles each stakeholder could play during each ERP-implementation phase (consultation, participation, fulfillment, authorization, and support). During the preimplementation phase, only four roles ensued, with the participation role not played by any of the six stakeholder groups (Nour & Mouakket, 2011). The unit of analysis was a team of individuals representing each stakeholder group involved in the preimplementation phase of the REPFMP initiative (see Table 1).

Table 1

List of Participants

Stakeholder/Role	From government	From IFI	No. of individuals
Top management/Authorization	Director general of treasury	Country-based head economist	2 (1 from government and 1 from IFI)
IS department/Support	Special advisor on ICT for the finance minister	—	1
Project team/Fulfillment	Heads and key members of PIU and procurement team	Project manager, key team member, & procurement specialist	6 (3 from government and 3 from IFI)
Organization/Consultation	Special advisor to the finance minister	Head of digital government practice at headquarters	2 (1 from each group)
Vendor/Consultation	Team leader & key member of the IVV team	—	2

Note. IFI = international financing institution, IS = information systems, ICT = information and communications technology, PIU = project implementation unit, IVV = independent validation and verification.

Various stakeholder groups view ERP system success differently over the life of the implementation cycle (Nour & Mouakket, 2011). For end users, ERP success depends on user satisfaction with the new ERP system. From the top-management perspective, success surrounds resource issues, performance factors, and strategic-impact considerations. The role of the information-systems department throughout the life of an ERP project is support, ranging from providing technical resources to the ERP project team to managing and maintaining the system postimplementation. The role of the project team is to deliver a successful implementation that fulfills the completion criteria of being on time, on budget, and with reasonable effort. From the organizational perspective, ERP success reflects the overall success of an organization. Success from the vendor's point of view revolves around its own reputation and ability to deliver the services. Accordingly, during the preimplementation phase of an ERP implementation, the end users, organization, and the vendor play the consultation role, whereas the top management plays the authorization role, the information-system department plays the support role, and the project team plays the fulfillment role.

For this case study, given the time period of focus and the organizational culture, end users were not relevant and were not one of the stakeholder groups studied. Top management members were those from the case government and from the IFI, including the Director General of Treasury from the government side, who was promoted to be the secretary general of the ministry during the studied period, and the country-based head economist from the IFI side. Two directors general and two country-based head economists had posts during the studied period. The director general was the champion of the project and the country-based head economist was the counterpart from the IFI side.

The special advisor on information and communications technology (ICT) for the finance ministry of the case country represented the information-systems department stakeholder group. Other participants included project-team heads and key members of the project-implementation unit, the procurement unit from the government side, and the project manager, team member, and procurement specialist from the IFI side assigned to the REPFMP. Six members, three from the government and three from the IFI, were selected to represent project-team stakeholders.

Representing the organizational perspective were the special advisor to the finance minister of the case country and the head of the digital government practice group of the IFI at its headquarters. For the vendor stakeholder group, the team manager and a key team member of the independent verification and validation (IVV) consultancy engaged by the government to assist the government to evaluate the bid proposals were used as a proxy for this group, given that public procurement has limited interaction between the government (buyer of the goods and services) and the vendor (suppliers of the goods and services) to ensure a fair and transparent procurement process.

In sum, a small pool of 13 key persons were selected to participate in the study, listed in Table 1, to provide the emic view of events. These individuals were at their posts during the studied period. Furthermore, given the unique positions of the individuals during the studied period, interviews were what Yin (2012) referenced as elite interviews, given the particular insights they provided that might not be possible from groups.

Ethical Considerations

Prior to the interviews, the researcher obtained informed consent from interviewees. The researcher advised interviewees of their rights to privacy and the ability to withdraw from the study at any time (see Appendices B and C).

Research Procedures

In this case study, the researcher investigated how and why knowledge flows unevenly across stakeholders through an organization. The three sources of data were project-related documentation, archival records, and interviews. Together, these sources of evidence facilitated triangulation of collected data. Further analysis of the data was conducted to link data on flows of need knowledge across the five different stakeholders through organization of the proposition that need knowledge flows could be explained by Nissen's (2014) multidimensional knowledge-flow model.

Before collecting any data, the researcher developed what Yin (2012, 2014) referenced as the case-study protocol, detailed below. This protocol was important in providing a consistent mental framework to logically link data to propositions throughout the data-collection process. The case-study protocol is different from the interview protocol in that the former aims at the researcher, whereas the latter, the interviewees. Yin (2014) proposed that a case-study protocol should have four parts:

1. an overview of the case study that includes the objectives, issues, and topics being studied;
2. data-collection procedures that include sources of data, procedures to protect human subjects, and logistical issues to carry out the study;

3. data-collection questions, which are different from the interview protocol, that a researcher should keep in mind during the data-collection process; and
4. a guide for the case-study report that includes use and format of the data and their presentation.

Overview of the Case Study

As discussed above, knowledge is a sustainable advantage and knowledge assets increase value with use. This snowball effect of knowledge advantage advocates effective knowledge management and fosters its continual growth as it flows. The problem is that knowledge flows unevenly throughout an organization and the fundamental dynamics of these flows are still not well characterized in theoretical and computational models.

This research built on existing work—knowledge-flow theory, need knowledge generation, and CSFs for ERP implementation—to explain the multidimensional knowledge-flow phenomenon in context, using a real-life immersion case. Specifically, the case study aimed to validate and extend Nissen's (2014) multidimensional knowledge-flow model to explain the flow of need knowledge described by Pourzolfaghar et al. (2013) and Kaiser et al. (2014) across Nour and Mouakket's (2011) fundamental stakeholders of an ERP project during the preimplementation phase of REPFMP, a real-life project. The theoretical framework for the proposed case study is depicted in Figure 2.

The REPFMP case was chosen because of the knowledge-rich procurement process that lasted 4.5 years. The REPFMP served as an instrumental case as defined by Creswell (2013)—one bounded case to illustrate one issue—to illustrate the

multidimensionality of the knowledge-flow phenomenon. Data were collected expressly to address the research questions.

Data-Collection Procedures

The case study used three sources of evidence: project-related documentation (semiannual progress reports, a midterm evaluation, and monitoring mission reports), internal archival records (e-mails, formal correspondence, legal documents, and minutes of meetings), and open-ended interviews. Before the interview part of the data-collection process, the researcher collected and reviewed project-related documentation (obtained through project team members), and internal archival records filed online in the IFI's REPFMP project portal.

As mentioned above, being a current staff member of the IFI, the researcher was able to obtain project-related documentation from project team members, and to access the IFI project portal to gather internal archival records dated from December 2004 to July 2009. The researcher assembled all ERP procurement items mentioned in these documents to build a chronology into a logic-model framework (aligned with Yin, 2014) on the chain of events that delayed the procurement process and those that eventually led toward contract signing in July 2009. The actual chronology of 4.5 years of empirical events occurring during the ERP procurement period was then benchmarked against the theoretically predicted events originally planned to take only 14 months. This logic-model framework was used as the preliminary analytic technique to present the dates of the events, initial explanatory propositions, sources of evidence, and gaps in the explanations. The logic model data-analysis technique was appropriate at this point, as the goal was to match empirically observed events to theoretically predicted events (Yin,

2014). Once data from all three sources of evidence were collected, the explanation-building data-analysis technique was employed, described in the next subsection. This desk-review step further sharpened the open-ended questions for the interview protocol by clarifying and strengthening the framework of explanations. The multiple sources of evidence contributed to the triangulation process to ensure the overall validity of the study. More importantly, this step informed the case-study protocol to increase reliability of the case-study research (Yin, 2014).

Before conducting any interviews, the researcher sought IRB approval. Given the relatively small sampling and unique positions of the interviewees or participants, the case is completely sanitized with the name of the real-life project fictionalized and name of country and IFI involved in delivering the project unidentified. Table 1 lists the 13 participants representing the five stakeholder groups and their respective roles. To further ensure anonymity of participants, the researcher assigned special codes to each interviewee, known only to the researcher.

Potential participants were contacted after the IRB granted approval. Participants were first contacted by e-mail or telephone through a short-message service. Once targeted participants agreed to be interviewed with date and venue confirmed, the researcher e-mailed each of them the formal request letter (Appendix C) along with the informed-consent form (Appendix D) for their signatures. Interviews were conducted either face-to-face or through a Skype video link, depending on the location of the interviewees. Field notes were taken during all interview sessions for further analysis. Each informed-consent form was either signed by the participant at the beginning of the face-to-face interview or the interviewee signed the form and e-mailed a scanned copy to

the researcher before the scheduled interview. A copy of the informed-consent form and sample letter requesting participation in the study are presented in Appendices B and C, respectively.

Data-Collection Questions

It was assumed that the uneven flow of need knowledge across different stakeholders led to delays in the procurement process and these delays could be explained by a multidimensional knowledge-flow model. This assumption guided the actual line of inquiry for the researcher to maintain a consistent mental framework during the data-collection stage. These questions were for the researcher and were different from those in the interview protocol, which were for the interviewees. The following three questions served as the researcher's mental line of inquiry (aligned with Yin, 2014):

1. How did knowledge flow in REPFMP (an overview of actual versus planned)?
2. Who needed what kind of knowledge to advance or hinder its flow (addressing the explicitness, reach, life cycle, and knowledge-power dimensions)?
3. How quickly did need knowledge flow from individual to group to organization, and the reverse (addressing the reach and time dimensions)?

Steps and Timeline for Data Collection

As this study involved human participants through interviews, IRB approval was sought. Once the IRB granted approval for the proposal and following the proposal-defense session, the researcher started to gather and review project-related documentation and archival records dating from December 2004 to July 2009. As discussed above, the

researcher obtained project-related documentation from project team members and the archival records were gathered online from the IFI internal website. All relevant documents and records were reviewed, and data organized. Concurrently, the researcher started to contact potential interviewees.

The following points summarize the steps the researcher took to collect data from the three targeted sources: project-related documentation, interviews, and archival records:

- Step 1: The researcher gathered project-related documentation (semiannual reports, monitoring mission reports, and the midterm report) from project team members. The researcher also logged onto the REPFMP project portal in the IFI internal website to view archival records (e-mails, minutes of meeting, formal correspondence, and legal documents). The researcher focused on collecting documents covering the period December 2004 to July 2009.
- Step 2: The researcher reviewed all project-related documents, took notes, and formed emerging themes.
- Step 3: Based on the initial data analysis of the etic view of events, the researcher reviewed to modify the interview protocol, but no modification was needed.
- Step 4: Potential participants were contacted by e-mail or telephone through a short-message service. During this initial contact, tentative appointments were made.

- Step 5: At least a day before each appointment, the researcher e-mailed the informed-consent form along with the formal letter requesting participation, including the time and venue of the appointment.
- Step 6: One day before or on the day of each interview appointment, the researcher reconfirmed the appointment time and venue by telephone through a short-message service or e-mail.
- Step 7: The researcher made field notes during all interviews. All field notes were typed and e-mailed to all interviewees for their review and confirmation. Six responded to the typed summary field notes. Four respondents provided additional clarifications in writing and the other two confirmed that the typed notes reflected the interviews. The interviews were mostly conducted face-to-face with three taking place on Skype.
- Step 8: After collecting the emic view of events, the researcher shifted focus back to the etic view by logging onto the REPFMP project portal in the IFI internal website to study the archival records (e-mails, minutes of meeting, formal correspondence, and legal documents). Notes were made while on line.
- Step 9: The three sources of data were organized to provide a chronology of 4.5 years of ERP procurement events and a preliminary arrangement of emerging themes toward some initial explanatory propositions, based on the sources of evidence.

The explanation building began, based on a review of documents, providing the etic view of the events. The emic view of events from the interviewees were collected once the interviews were conducted.

Data Analysis

Data analysis was an iterative process and began during data collection to maximize the effectiveness of data collection and to minimize the time needed to report the findings. Once data from all three sources of evidence were collected and organized, data analysis was underway by playing with the data (aligned with Yin, 2014), to search for emerging patterns, insights, and themes that related directly to the research questions. To facilitate this initial data manipulation, Yin (2014) suggested putting data in arrays, displays, tabulations, diagrams, or memos, as used by grounded-theory practitioners. Yin (2014) further proposed four general strategies to guide the data-analysis process with five analytic techniques or tools. The four strategies are to (a) rely on theoretical propositions, (b) work the data from the ground up, (c) develop a case description, and (d) examine plausible rival explanations. The five analytic techniques include pattern matching, explanation building, time-series analysis, logic models, and cross-case synthesis.

For this case study, the researcher followed the theoretical propositions espoused in the five dimensions of Nissen's (2014) multidimensional knowledge-flow model, the concept of need knowledge advocated in Kaiser et al. (2014) and Pourzolfaghar et al. (2013), and the three critical-success-factor dimensions in Nour and Mouakket's (2011) ERP successful-implementation framework (see Figure 2). In conjunction, these theoretical propositions became the criteria to guide the data-analysis process to explain the multidimensionality and unevenness of need knowledge flows across five stakeholder groups during the preimplementation phase of an ERP project. Accordingly, given that the goal was to build an explanation of the case, the analytic technique chosen was

explanation building, with Nissen's (2014) 5D knowledge-flow model as the evaluative framework. To ensure the robustness of conclusions derived, throughout the research process, the researcher sought rival explanations (as described by Yin, 2014) to enrich the research findings. Given the evaluative framework and theoretical orientation, the potential pitfalls in the explanation-building technique were safeguarded.

Presentation of the Results

The study results and conclusions are presented in Chapters 4 and 5 of this dissertation report. Chapter 4 focuses on the first and introduces the second of the following three components. Chapter 5 expands on the second and concludes with the third component of the study results:

1. A chronology of key events that obstructed knowledge flow,
2. A logic model depicting themes that contributed to knowledge-flow obstruction, and
3. Explanations of the knowledge-flow patterns for this case study

Chapter 5 of the report also includes a summary of good practices for organizations to better harness knowledge for their specific improvement initiatives and overall competitive advantage. In addition, a summary report could be presented to the IFI and one professional conference such as the Hawaii International Conference on System Sciences.

Summary

In sum, the case-study strategy was followed to develop an explanation of why knowledge flows differently across stakeholders (a contemporary phenomenon) in the context of the REPFMP (a real-life context) by using Nissen's (2014) multidimensional

knowledge-flow model (an a priori theoretical proposition) to generalize how knowledge flows in an organization. For this study case, the five research design components were as follows:

1. Research questions: How can need knowledge and its flow across different stakeholders in an organization over time be explained using a multidimensional knowledge-flow model? and How can Nissen's (2014) 5D knowledge-flow model be validated using a real-life immersion case?
2. Research proposition: First, this work validated Nissen's (2014) proposed 5D knowledge-flow model, which has limited empirical work, by considering the multidimensional aspects of knowledge flow in a real-life ERP project. Second, the research adopted the five stakeholder groups defined by Nour and Mouakket (2011), thereby expanding on Pourzolfaghar et al.'s (2013) work with only two stakeholder groups. Third, the study was longitudinal to cover the multiyear (2004–2009) preimplementation phase of an ERP initiative, departing from the work of Pourzolfaghar et al. and Kaiser et al. (2014), who considered relatively shorter time horizons.
3. Unit of analysis: The unit of analysis was a team of individuals representing the five stakeholder groups—top management, IS department, project team, organization, and vendor—involved in the preimplementation phase of FMIS implementation under the REPFMP initiative.
4. Linking data to the proposition: This study used three sources of data—project-related documentation, archival records, and interviews—to capture uneven flow of need knowledge through an organization. These different

sources of evidence facilitated triangulation of the collected data. Data analysis relied on linking data on flows of need knowledge across the five stakeholders through an organization of the proposition that need knowledge flows can be explained by Nissen's (2014) multidimensional knowledge-flow model.

5. Criteria for interpreting data: The data-analysis strategy adopted for the study followed the theoretical propositions espoused in the five dimensions in Nissen's (2014) multidimensional knowledge-flow model, the concept of need knowledge advocated in Kaiser et al. (2014) and Pourzolfaghar et al. (2013), and the three critical-success-factor dimensions in Nour and Mouakket's (2011) ERP successful-implementation framework. These theoretical propositions together became the criteria to guide the data-analysis process to explain the multidimensionality and unevenness of need knowledge flows across five stakeholder groups during the preimplementation phase of an ERP project.

Chapter 4

Results

This case study utilized three sources of evidence: project-related documentation (semiannual progress reports, a midterm evaluation, and monitoring mission reports), internal archival records (e-mails, formal correspondence, legal documents, and minutes of meetings), and open-ended interviews. The evidence was gathered to answer the two-pronged research question: How can need knowledge and its flow across different stakeholders in an organization over time be explained using a multidimensional knowledge-flow model? and How can Nissen's (2014) 5D knowledge-flow model be validated using a real-life immersion case? The first prong of the research question comprises four elements: need knowledge, stakeholders, knowledge flow, and a multidimensional knowledge-flow model. The second prong of the research question specifies the multidimensional model: Nissen's (2014) 5D knowledge-flow model. The premise was that by explaining real-life need knowledge flows using Nissen's model (Research Question 1), Nissen's model would be validated (Research Question 2). Furthermore, with the additional elements of need knowledge and stakeholders incorporated into the knowledge-flow model, the goal of the study—to validate and extend Nissen's 5D knowledge-flow model—would be achieved.

For the first source of evidence, project-related documentation, the researcher was able to obtain resources from the government and IFI project team members. The government side had eight government-produced semiannual reports that included one

midterm review. The IFI side included seven monitoring mission reports, one project consideration document dated 2004, and one project completion report dated 2016.

The researcher collected the next source of evidence through interviews with a small pool of 13 key persons (see Table 1), who were at their posts during the study period, representing the five stakeholder groups relevant to the preimplementation phase of an ERP project, as postulated by Nour and Mouakket (2011): top management, information-systems department, project team, organization, and vendor. The sixth stakeholder group, end user, was not included, as this group was not involved at this stage of the ERP implementation for this case study. These interviews were what Yin (2014) referenced as elite interviews, given that the particular insights participants provided would not be possible from groups.

For the organization-stakeholder group, the researcher initially planned to interview the finance minister and the country director of the IFI. However, the researcher was not able to secure an appointment through the minister's chief of staff. The minister also did not respond to the letter, fax, or e-mail sent. The researcher therefore took the suggestion of two of the interviewees and contacted the minister's special advisor, who was instrumental in unblocking the last procurement impasse that eventually led to contract signing of the ERP implementation. The IFI country director declined to be interviewed, citing that events were too far in the past to remember.

The researcher then chose the head of the digital government practice group based at IFI headquarters. This practice group is the IFI's global knowledge center for e-government projects, including the FMIS-type. Because these two interviewees were not personally involved in the REPFMP, their participation lent particular objectivity that

might not have been attained if the two individuals originally identified had agreed to be interviewed. All interviews were transcribed and returned to interviewees for review and comment. Six responded, four sending clarifications and slight revisions and two confirming that the transcription reflected the exchanges during the interviews.

For the third source of evidence, the researcher accessed the IFI's internal project portal to gather internal archival records dated from December 2004 to July 2009. The project portal displayed 20 entries per screen page. Each displayed entry contained either e-mail or attachments such as formal correspondence, legal documents, or meeting minutes. The researcher scanned the 110 screen pages totaling 2,180 entries.

After organizing all three sources of evidence, making notes while reviewing the documents, a chronology of the events that occurred during the 54-month ERP procurement period took shape. The chronology was primarily based on project-related documentation and archival records, which were factual and mutually corroborated the etic view of "what happened." The interviews provided the emic view of "why it happened." Although the interviewees might not remember the exact dates when certain events took place, they were all accurate in remembering the sequence of key events. All interviewees appeared to be comfortable discussing their weaknesses and strengths during the studied period. Archival records provided the exact dates of events, primarily with attachments of formal correspondence captured and recorded verbatim in government progress reports and IFI mission reports. The minimal number of informal e-mails appeared to be confirmation of more lengthy and detailed discussions and agreed actions made offline and recorded in government and IFI reports. These archival entries collectively reinforced and elaborated on the data from the interviews and project-related

documentation. The remainder of this chapter presents two of the three components of this case study:

1. A chronology of key events that obstructed knowledge flow, and
2. A logic model depicting themes that contributed to knowledge-flow obstructions.

Figure 3 shows the structure of the remainder of Chapter 4, starting with the chronological context of the case. The chronology provides the context for the study of the interplay of need knowledge and stakeholder groups and how the researcher used a multidimensional knowledge-flow model to explain the knowledge-flow phenomenon. Nissen (2014) noted that knowledge does not flow quickly, directly, and powerfully and there are obstructions to knowledge flows. Therefore, the logic model is a tool to understand these knowledge-flow obstructions.

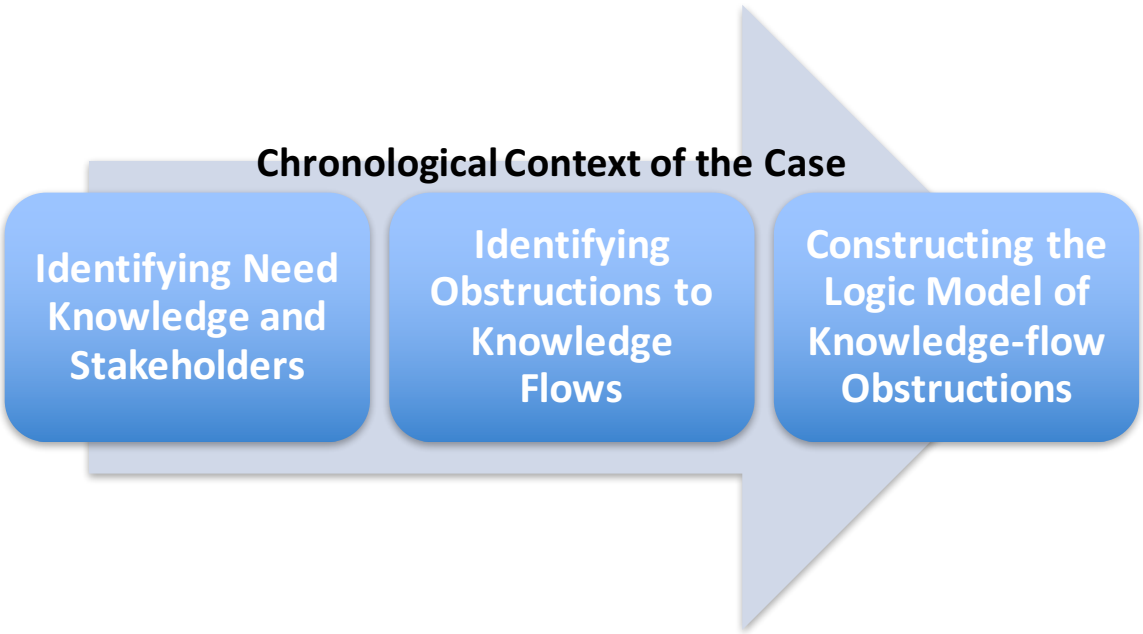

Figure 3. Toward a logic model of knowledge-flow obstructions.

Chronological Context of the Case

The preimplementation phase of the FMIS under REPFMP was the period from the date the loan was signed between the government of the case study and the IFI in December 2004 to the date the ERP system-implementation contract was signed between the government of the case study and the winning contractor in July 2009. Figure 4 depicts the 54-month preimplementation phase compared to the 14-month critical path estimated during the planning of the REPFMP. For this case study, the preimplementation phase is the procurement period and can be viewed as three distinct stages: bid-document preparation, first-stage bidding, and second-stage bidding. All planned dates were more than tripled in duration from the planned ones.

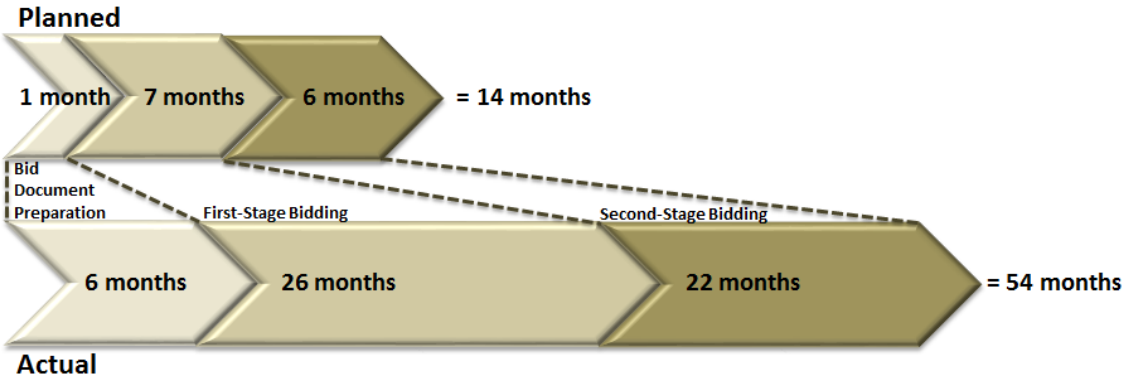

Figure 4. Planned versus actual: Preimplementation phase of an ERP project.

The original plan was to allocate about 1 month to finalize the bid document because the government had already prepared a preliminary set of functional and technical specifications for the IS to be procured before the loan was signed. At the end, it took 6 months. The government managed to engage a consulting team to review, update, revise, and finalize the bid document soon after loan signing. According to members of the project team and vendor stakeholder groups, the resulting bid document

lacked government ownership because the consulting team worked primarily on their own with minimal consultation with other stakeholders. One interviewee from the top-management stakeholder group stated that, at the time, no government structure allowed dedicated staff to work alongside consultants to prepare the bid document. As a result, the need knowledge related to ERP embedded in the bid document did not flow directly, quickly, or powerfully to the project-team stakeholder group tasked with fulfilling the procurement process. This bid document was released to the public in September 2005 and the first-stage bidding of the procurement process began.

The planned 7-month first-stage bidding process took 26 months. The REPFMP project took into account that the government did not possess the need knowledge related to ERP in its design. The REPFMP project-consideration document—the design document covering the context, rationale, expected results, design, scope, timeline, implementation approaches, associated costs, and loan amounts—included a requirement for the government to engage a consultancy firm to provide IVV services to support the government in procurement and project-management of the implementation of the ERP system. The IVV team was hired around the time the bid document was released. In this case study, the IVV team was considered a proxy for the vendor stakeholder group, given their knowledge and expertise in ERP systems, and one of the first knowledge products the IVV generated was the evaluation framework for IVV and government teams to follow to ensure consistency in the evaluation approach and criteria. The government received four bid proposals in November 2005, and according to a member of the vendor stakeholder group; the IVV team completed the bid evaluation by January 2006. The same interviewee said it took the government 2 months to reconcile its report with that of

the IVV. The government submitted the bid evaluation report to the IFI in March 2006 for the latter's no-objection to proceed to the second-stage of the procurement process.

The evaluation report included a detailed contract to be signed between the government and the successful bidder for the implementation of the ERP system. The entire contents of the evaluation report, including the contract and names of qualified bidders to proceed to the second stage of the bidding process required a formal no-objection response from the IFI, which was issued in May 2006. This marked the beginning of a series of revisions, clarifications, and responses between the government and the IFI on content and conclusions in the evaluation report, which lasted until October 2007, when the second-stage bid document was distributed to the three qualified bidders to proceed to the second stage of the bidding process (based on archival records).

According to one member of the project-team stakeholder group, the two-stage ICT-procurement process was a new approach the IFI initiated in 2004 along with the release of a sample bid document that included a sample contract. Further, the interviewee stated the REPFMP was a test case for the IFI. The first stage focused on determining the best qualified solutions submitted. The top-qualified solutions would then advance to the second stage to compete for the lowest cost and best solution, leaving the evaluation of the cost proposals for the second stage. According to a member of the organization stakeholder group, the two-stage procurement process was an innovation with no success story recorded when the loan for the REPFMP project was signed.

It took 15 months for the government and the IFI to agree on whether to disqualify some of the bidders. The government team insisted that only one bidder was qualified to proceed to the second stage. Based on interviews with the vendor and the

project-team stakeholder groups, as well as archived no-objection letters issued by the IFI, the IVV and IFI teams independently considered more than one qualified bidder. One member of the vendor stakeholder group reasoned that additional bidders would provide alternative solutions from which the government could choose and produce more competitive bid pricing. It was too early in the bidding process to single out one frontrunner.

During these exchanges, the president of the IFI received an anonymous letter at IFI headquarters complaining of nepotism practiced by the government project team (archival records). The finance minister responded by calling for an independent evaluation of the IFI's handling of the procurement process (archival records). The IFI obliged by engaging a third party to conduct an investigation in the form of a desk review of all relevant documents related to the bidding process to date. The investigation took about 4 months, resulting in a report stating that the IFI had handled the procurement process properly. The government project team qualified three bidders to advance to the second-stage bidding process.

The six-month second-stage bidding process took 22 months. Given that second-stage bids were primarily on the financial aspect, bidders had 6 weeks to submit their proposals with the bid opening date set for late November 2007. Only two bids were submitted, and the bids were eventually opened in April 2008. The 5-month delay in the bid opening occurred because the minister decided that a complete review of the FMIS project was needed to reevaluate whether the perceived benefits of the ERP system were still relevant to the finance ministry more than 3 years since loan signing. According to the members of the vendor, project-team, and top-management stakeholder groups, the

review of the relevance of the FMIS also served to build ownership among the rank and file. The minister assigned a special advisor to conduct this internal review during the first quarter of 2008. According to members of the information-system department and organization stakeholder groups, this special advisor was chosen to conduct the review because the advisor had just returned from a multiyear assignment overseas, and was never involved in the design or preparation of the REPFMP, and, therefore would be impartial.

By the time the bid opening took place in April 2008, the review was submitted to the minister, reaffirming the relevance of the FMIS project. It was, however, still 15 months until the end of the preimplementation phase of the FMIS project, as both bids were rejected immediately on the bid opening date due to noncompliance. The government proposed a "*redo*" of the second-stage. According to members of the project-team and vendor stakeholder groups, the "redo" presented an opportunity to update the more than 3-year-old bid document and to include requirements from the directorate-general of budget, a unit that had been resistant to participating in the project until now. One interviewee said the delay was a "blessing in disguise" as it provided time for a more complete requirement specification in the bid document.

The qualified second-stage bidders received the revised bid document in August 2008 with bid opening set for October 2008. The consolidated bid-evaluation report, one by the IVV team and the other by the government team, was submitted to the IFI in February 2009. In May 2009, the IFI issued its no-objection after three rounds of clarification requests, and the contract was signed in July 2009.

Need Knowledge and Stakeholders

This case study focused on the preimplementation phase of an ERP project. The need knowledge is accordingly in the procurement domain. Gaining procurement knowledge would facilitate and accelerate the acquisition of the ERP IS needed to improve the efficiency and effectiveness of the finance ministry's public financial management. The desired knowledge flow for the ministry would inevitably be for procurement knowledge to flow quickly, directly, and with high power. For an organization to rapidly gain and directly apply new knowledge—completing the knowledge-flow loop across the organization—Nissen (2014) postulated that the knowledge would need to stay on the tacit-knowledge plane, or the bottom plane in the three-dimensional Cartesian coordinate system that represents the 5D knowledge-flow model described in Chapter 3. As organizations in general lack processes to support direct, quick, and powerful knowledge flow, obstruction often exists along the knowledge-flow path (Nissen, 2014). In this section, the focus is on need knowledge as observed from this case study. The next section describes obstructions to knowledge flow.

Pourzolfaghar et al. (2013) noted that different types of stakeholders require different knowledge during the architectural conceptual-design phase of a green-building project. Kaiser et al. (2014) built a theoretical framework to capture need knowledge for different stakeholders in the Austrian bakery industry. In this case study, different types of need knowledge arose and different stakeholder groups possessed or gained different types of need knowledge. For example, the knowledge initiated by the organization stakeholder group in the form of a review of the procurement process was different from

the type of knowledge the vendor stakeholder group brought on the ERP system. This knowledge possessed by the vendor stakeholder group was again different from that of the project-team stakeholder group, which was primarily focused on the mechanics of processing a procurement.

The procurement process was fulfilled by the project-team stakeholder group. The need knowledge the project-team stakeholder group expected to have in this case study to fulfill the procurement process was the mechanics or the knowledge of how to process a procurement, such as preparing the bid document, advertising or requesting proposals, evaluating the proposals, reporting on the bid evaluation, negotiating with the winning bidder, and arranging contract signing.

As noted in the previous section, the government engaged a consultancy to prepare the bid document. The project team therefore acquired the bid document knowledge by hiring a firm that could provide such consultancy services. The project team attended a series of training sessions supplied by the IFI to gain knowledge of how to process procurement financed by the IFI; however, these training sessions did not seem to provide the right knowledge in completing the procurement process. One member of the project-team stakeholder group complained that these "training sessions were theory-based, with no situational problem-solving simulations." In addition to training sessions by the IFI, the project team also gained knowledge on bid evaluation delivered by the government-hired IVV team. As described in the previous section, the IVV team developed evaluation templates for the IVV and project teams to use. Given that the project team did not have the need knowledge on ERP systems, as noted in the project consideration document—which was also highlighted by almost all members in all

stakeholder groups, except those in the organization stakeholder group—the role of the IVV team was also to fill the knowledge gap related to ERP systems. In addition, knowledge on ERP was embedded in the bid document prepared by another consultancy. In theory, the project-team stakeholder group tasked to fulfill the procurement (completing the knowledge-flow loop) should have in its possession two types of need knowledge: procurement and ERP. It appeared that both types of need knowledge were required for the procurement process and thus to advance the knowledge flow. In reality, it took the project team a long time to embrace ERP need knowledge, cited in the fourth progress report prepared by the government, averring "significant under-utilization of the IVV knowledge."

In addition to the two types of need knowledge described above, a third type of need knowledge emerged from the collected data. During both stages of the procurement process, members of the government project team applied their procurement knowledge combined with ERP and related technical knowledge imported from the vendor stakeholder group (the IVV team) and the information-system stakeholder group (members of the procurement evaluation team) to complete the bids evaluation. To complete the procurement process, top management authorized the sign-off of evaluation results under consultation with the organization stakeholder group. During the first-stage procurement process, the minister, representing the organization stakeholder group, called for an independent evaluation of IFI's conduct of the procurement process. The findings of that evaluation became a different type of need knowledge to authorize advancement to the second-stage bidding process. During the second-stage bidding process, the minister requested a review of the ERP project to ensure it was still relevant

to the ministry. The review reaffirmed that the ERP system remained highly relevant, and the review finding was the need knowledge that underpinned the authorizing environment generated to complete the knowledge-flow loop.

This section describes the interplay of need knowledge and stakeholder groups, identifying three points. First, three types of need knowledge emerged: procurement, ERP, and authorizing. Second, different stakeholder groups possessed different need knowledge. Third, the presence or absence of all three types of need knowledge seemed to determine whether the knowledge flow would complete its loop. The next section brings in Nissen's (2014) 5D knowledge-flow model, revealing obstructions to the flow of need knowledge across different stakeholder groups.

Obstructions to Knowledge Flows

Nissen (2014) proposed a 5D knowledge-flow model to characterize a particular knowledge in four dimensions—reach, explicitness, lifecycle, and flow time—and to represent the efficacy in achieving a knowledge-based action in the knowledge-power dimension. As stated in the previous section, because organizations in general lack processes to support direct, quick, and powerful knowledge flow, the knowledge-flow path often has obstructions (Nissen, 2014). Nissen (2014) described two archetypical 5D knowledge-flow patterns to represent an organization's capabilities, including areas of knowledge-flow obstructions. Further, two archetypical knowledge-flow patterns can have multiple permutations and the "5D space enables one to understand, visualize and analyze every knowledge flow in any comprehensible organization" (Nissen, 2014, p. 81).

This case study collected three sets of evidence. Interviews with members of stakeholder groups presented one of the three sources of evidence for this case study. The other two sources were project-related documentation and archival records. Summary of the interviews is in Appendix E and the synthesis of all three sets of evidence is in Appendix F. Table 1 in Chapter 3 lists the 13 interviewees who represented the five stakeholder groups during the preimplementation phase of an ERP system. As discussed in Chapter 3, for this case study, only five stakeholder groups—organization, vendor, information-systems department, project team, and top management—were relevant during the FMIS preimplementation phase. Following Nour and Mouakket's (2011) critical-success-factor framework for ERP implementation, organization and vendor stakeholder groups took on the role of consultation, IS department the role of support, project team the role of fulfillment, and top management the role of authorization. The overarching guiding question posed during the interviews was to encourage interviewees to describe their overall individual experience. The following five interrelated open-ended questions teased out factors that contributed to knowledge-flow obstructions:

1. *Overall experiences*: What were your experiences? Did you feel equipped with the right knowledge to do your tasks?
2. *Main counterparts*: Who were your main counterparts, internal and external?
3. *Knowledge-sharing*: How did you communicate, exchange/share knowledge, or first know about anything among the different individuals and groups?
4. *Key stumbling blocks*: What were the key stumbling blocks and how were these resolved?

5. *Doing differently*: What would you do differently if you had the opportunity to start again?

The first question on overall experiences was a warm-up question intended to help bring interviewees back to events that happened a decade ago. The second and third questions explored with whom and how the interviewees shared knowledge. The fourth question aimed to identify perceived obstructions to knowledge flow. The last question was a minisession to simulate learning from the future, described by Kaiser et al. (2014) to envision the organization's need knowledge acquisition and application approaches in the future to sustain competitiveness through these transformative initiatives such as adopting or implementing an ERP system. The interview protocol is in Appendix A and a summary of the interviews of the five stakeholder groups, organized by each of the questions above, is in table form in Appendix E.

The interplay between need knowledge and stakeholder groups was discussed in the previous section. It appeared that different stakeholder groups possessed different types of need knowledge. The data further suggested that the presence of all three types of need knowledge at the right time determined the forward movement of the knowledge flow. This section explores factors that obstructed the flow of need knowledge. For this case study and studied period, the need knowledge is in the procurement domain and the obstructions to the flow of need knowledge correspond to causes for procurement delays.

Almost all members of the project team stakeholder group, when asked about their overall experience with the REPFMP during the preimplementation stage of the FMIS, used the term resistance as the main cause for procurement delays. All members of the project-team stakeholder group complained that the government project team could

only work on the FMIS procurement after completing their regular work duties as government officials. The second government-produced semiannual progress report, dated October 2006, cited “part-time involvement of procurement committee” as one of the reasons for delays. This situation was corroborated by the vendor stakeholder group who said that officials would schedule blocks of time and were “sequestered” in a hotel for multiple days to weeks to work on bids evaluation. This was also mentioned in the fifth IFI mission report dated November 2017 that “procurement team should start with a retreat on bid evaluation.”

In addition, staff rotation and absenteeism was constant. The fourth IFI mission report highlighted one concern that “body of knowledge and experience gained over almost a three-year period through formal training and on-the-job practice could be lost due to staff re-assignments.” One member of the vendor stakeholder group said it took almost 1 year to stabilize the procurement team of about 20 regular contributors. Initially, up to 80 officials were selected to process the procurement, but only 20 attended the training designed by the vendor stakeholder group to align methodologies used by the project team and the IVV team on their separate and independent evaluation of submitted bids. However, not the same 20 turned up for the actual bid evaluation sessions. A member of the top-management stakeholder group went further and described a weakness in the government structure and said the ministry could not assign a dedicated unit to work solely on the REPFMP. At the beginning of the project (which was changed right before the ERP-implementation phase when a special unit was established in the directorate-general of treasury to implement the ERP system), the ministry could not assign staff to work alongside consultants to develop the bid document, resulting in “lack

of understanding of the details of the bid doc and lack of ownership for the bid doc." Another government project-team member, who was appointed to lead the procurement committee from the beginning of project, echoed this lack of ownership for the bid document.

Three themes came into focus on causes of knowledge-flow obstructions: resistance, peripatetic workforce, and organizational ownership. The next section delves more deeply into the data collected from all sources, triangulating the data, and using the logic model data-analysis technique described by Yin (2014) to derive the cause–effect results chain toward knowledge-flow obstructions.

Logic Model of Knowledge-flow Obstructions

The preceding section suggested three factors for knowledge-flow obstructions: resistance, peripatetic workforce, and organizational ownership. This section develops the cause–effect results chain using Yin's (2014) logic model data-analysis technique, depicted in Figure 5, to better understand the underlying causes for knowledge-flow obstructions.

The government's first progress report in March 2006 stated that "insufficient training on and understanding of procurement" was one of the main reasons for slow progress. The report suggested one of the measures to speed up procurement was "providing adequate training for team members to carry out their responsibilities." Insufficient training resulted in staff not able to perform duties, which in turn contributed to resisting doing the work. Lack of procurement training or inadequate training, discussed earlier in this chapter, was consistently mentioned in the first four government' progress reports and echoed by all stakeholder groups. Being "not able" to perform a

knowledge-based action (performing the procurement) resulted in resisting the action, noted in the upper left corner of Figure 5.

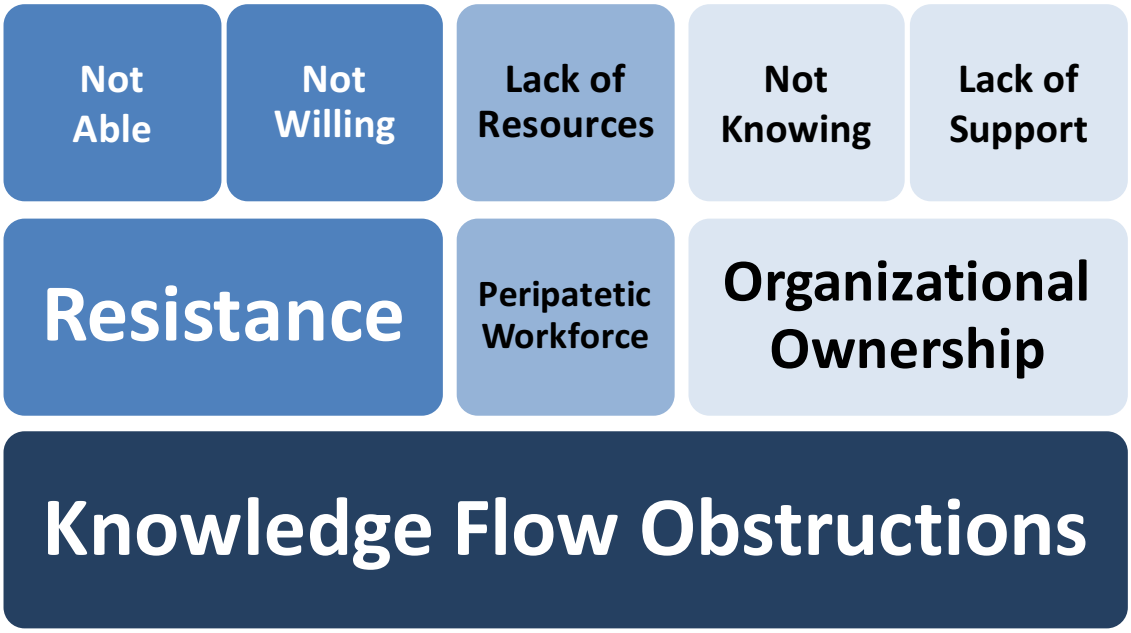

Figure 5. Logic model framework for knowledge flow obstructions.

One member of the government project-team stakeholder group pointed out they experienced "not a lot of support from outside of the directorate-general of treasury" and that within the directorate-general of treasury, only the director general and a few involved in the planning and design of the project were supportive. One project-team member prefaced the interview with the statement that the government had a certain unwillingness to adopt a ready-made ERP system, with some officials considering custom building a system. The third government' progress report, dated April 2007, stated that the IVV team "highlighted that it would be too risky to undertake in-house development due to limited IT capability within the ministry." Representatives of the IS department stakeholder group stated that even the directorate-general of treasury, where the FMIS was to be hosted, had strong opposition to the project with one of the senior

officials opposing the approach because an ongoing initiative to transform the operations of the branch offices of the directorate-general of treasury across the country might conflict with the new FMIS. Another perspective of this unwillingness to embrace the FMIS was brought about by a project-team member who described a reluctance to change, and in the directorate-general of treasury, some believed that "everything was good already and rejected new things automatically." Recorded in the government's third progress report dated April 2007 was that"

> At the level of [project implementation units], one cannot expect middle management and staff to align their interests automatically with a project espousing transparency, control and accountability, or one that promises automation efficiency gains that could be perceived as a threat to jobs.

"This "not willing" sentiment can be seen as rooted in certain self-interests to resist gaining new knowledge, which in turn adds another cause for the resistance condition in the logic model for knowledge-flow obstructions in Figure 5.

The government's March 2006 report stated "inadequate human resources and full-time staff" as another reason for slow progress. The need for dedicated full-time staff to work on the REPFMP was mentioned as a recommendation in the IFI's first monitoring mission report conducted in June 2016. The lack of dedicated staff to implement the REPFMP project was due partly to the ongoing ministerial organizational restructuring discussed in the third report. The fourth IFI mission report for the February–March 2007 mission also stated that, "While new structural unit was established that afforded full-time staff, existing counterpart team members might not be reappointed to the new structural unit." The fallout of the reassignment was that those trained might not be able to use their newly gained knowledge and a new set of project-team members would need to be trained. As discussed in previous sections, dedicated resources were

lacking throughout the preimplementation phase of the REPFMP and the structural unit was not in place until after the FMIS implementation contract was signed. The lack of resources contributed to the peripatetic workforce as another condition for the knowledge-flow obstructions depicted in Figure 5.

At a Steering Committee meeting for the REPFMP project conducted during the reporting period, the government's first progress report in March 2006 cited that the minister would "take a lead in ensuring successful implementation of the [project]." The ERP system was to be implemented at the directorate-general of treasury even though the system would have supported the entire ministry. One project-team member pointed out that the ongoing reorganization of the ministry entailed the splitting of one unit into two—the directorate-general of treasury and the directorate-general of budget—and with the split, "officials who were previously involved in project preparation were reassigned."

The IS-department stakeholder group noted that officials of directorate-general of budget were "dissenting groups." This ownership sentiment extended across the organization, observed by the top-management stakeholder group who said that there was no "public awareness campaign" to inform those outside the main implementing unit. Part of this awareness campaign was designed to be addressed by the change management and communications consultancy the government would procure under the REPFMP project, stipulated in the project-consideration document. Almost all IFI mission reports listed the procurement of this consultancy as a priority. This consultancy was to be in place at the start of the project during the preimplementation phase of the

FMIS, but this did not happen until after the contract for the FMIS implementation consultancy was signed.

The sixth government's progress report, dated November 2008, stated that "change management consultancy was not considered to be urgent till January 2010 when the FMIS was to be piloted." One members of the top-management stakeholder group said support was "not so good … better in the third year" and that improving support of stakeholders would empower the community of the finance ministry. The result was that most people across the ministry did not know much about the REPFMP project, as summed by a member of the project-team stakeholder group, indicating that not all units knew the purpose of the FMIS. "Not knowing" about the purpose of the FMIS underlay the "lack of support" for the REPFMP project as a whole. These two interrelated but distinct causes contributed to the organizational-ownership condition for knowledge-flow obstructions, as depicted in the right corner of Figure 5.

Using the logic-model data-analysis technique described by Yin (2014), and triangulating data collected, five factors are depicted in Figure 5: not able, not willing, lack of resources, not knowing, and lack of support. These five contribute to three conditions for knowledge-flow obstructions: resistance, peripatetic workforce, and organizational ownership. The five factors at the top level of the figure are basic or raw elements resulting in the three conditions—resistance, peripatetic workforce, and organizational ownership—represented in the second level of Figure 5 that cause knowledge-flow obstructions.

Further analysis to clarify the links between the two levels of the cause–effect chain—not able and not willing—are grouped as contributing to the resistance condition

toward knowledge-flow obstruction. Lack of dedicated resources results in a peripatetic workforce to advance a knowledge-based action, which in turn contributes to knowledge-flow obstruction. Not knowing and lack of support together reflect an ownership condition that could result in the narrow stakeholder base needed for organizational commitment to effect a knowledge-based action. These three conditions—resistance, peripatetic workforce, and organizational ownership—together provided an undesirable outcome of procurement delays in the studied case, and resulted in the phenomenon of knowledge-flow obstructions.

Summary of Results

This case study introduces a framework to address a two-pronged research question: How can need knowledge and its flow across stakeholders in an organization over time be explained using a multidimensional knowledge-flow model and how can Nissen's (2014) 5D knowledge-flow model be validated using a real-life immersion case? Nissen's (2014) 5D knowledge-flow model characterizes particular knowledge in four dimensions—reach, explicitness, lifecycle, flow time—and represents efficacy in achieving a knowledge-based action in the knowledge-power dimension. As depicted in Figure 2 and discussed in Chapter 3, the Kaiser et al. (2014) need knowledge designation and Nour and Mouakket's (2011) stakeholder groups in ERP implementation in the ERP CSF research stream contextualized this 5D model.

This research entailed collecting three sources of data—project-related documentation, archival records, and interviews—and presented the flow of need knowledge across stakeholders in an organization over time. This chapter discussed three types of need knowledge: procurement, ERP, and authorizing. Stakeholder groups

possessed different types of need knowledge, and the presence or absence of all three types of need knowledge determined whether the knowledge flow would complete its loop.

Nissen (2014) also postulated that because organizations in general lack processes to support direct, quick, and powerful knowledge flow, obstruction often emerges along the knowledge-flow path. Using the logic-model data-analysis technique described by Yin (2014), seemingly distinct concepts and idle phrases scattered across the collected data from all three data sources gained importance. Five basic factors—not able, not willing, lack of resources, not knowing, and lack of support—emerged as shown in Figure 5, contribute to knowledge-flow obstructions. The analysis further provided in the logic model's cause–effect results chain with three conditions—resistance, peripatetic workforce, and organizational ownership—caused knowledge-flow obstructions (see Figure 5). The interviews with the five stakeholder groups involved in the ERP preimplementation phase are summarized in Appendix E. Synthesis of all three datasets are collected in a five-by-five matrix in Appendix F, demonstrating the relationships between Nissen's (2014) five knowledge-flow dimensions and the five basic factors for knowledge-flow obstructions.

This case study adopted a three-pronged approach, using three results components to address the research question. This chapter presented two of the three results components: a chronology of key events that obstructed knowledge flow, and a logic model depicting themes that contributed to knowledge-flow obstruction. The chronology aimed to provide context for the study of the interplay of need knowledge and stakeholder groups and how a multidimensional knowledge-flow model explained the

knowledge-flow phenomenon. Nissen (2014) noted that knowledge does not flow quickly, directly, and powerfully and has obstructions. The logic model was a tool to understand these knowledge-flow obstructions. The discussions on the development of these two results components demonstrated that need knowledge flowed across stakeholder groups through multiple knowledge-flow obstructions in a multidimensional setting. The next chapter builds on the logic model to present the third result component, explaining the knowledge-flow patterns for this case study.

Chapter 5

Conclusions, Implications, Recommendations, and Summary

This case study merges three research streams—knowledge-flow, need knowledge, and ERP CSF—into one framework to address a two-pronged research question: How can need knowledge and its flow across stakeholders in an organization over time be explained using a multidimensional knowledge-flow model and how can Nissen's (2014) 5D knowledge-flow model be validated using a real-life immersion case? Chapter 4 presents two of three results components of this research. First, a chronology of key events that obstructed knowledge flow was developed to provide the context for the study, showing the interplay of need knowledge and stakeholder groups and how a multidimensional knowledge-flow model could explain the knowledge-flow phenomenon in this studied case. Second, a logic model depicting themes that contributed to Nissen's (2014) knowledge-flow obstructions was developed.

The development of the chronology and discussion of the logic-model analysis in Chapter 4 demonstrated that need knowledge flowed across stakeholder groups through a number of knowledge-flow obstructions in a multidimensional setting. This case study revealed three types of need knowledge: procurement, ERP, and authorizing. Each stakeholder group held a specific type of need knowledge, and all three types of need knowledge were necessary to advance the flow of knowledge to complete the knowledge loop. Chapter 4 also discusses three conditions associated with Nissen's (2014) knowledge-flow obstruction—resistance, peripatetic workforce, and organizational

ownership—that prevented need knowledge from flowing quickly, directly, and powerfully across the dimensions of the 5D knowledge-flow model.

This chapter explores these two results components further to present the third result component by generalizing the explanations of the knowledge-flow patterns for this case study, introduced in Chapter 4. A discussion of the limitations of the study, implications of this research, and potential future work follows this exploration. The chapter closes with a summary of this case study.

Conclusions

Chapter 4 shows that need knowledge flowed across stakeholder groups through multiple knowledge-flow obstructions in a multidimensional setting in the case studied. The discussion in Chapter 4 further demonstrated an approach to validate Nissen's (2014) 5D knowledge-flow model using a real-life immersion case, which in turn addresses the second prong of the research question. This section focuses on the first prong of the research question by introducing a set of analytic generalizations, aligned with Yin (2014), derived from the results presented in Chapter 4 to explain the flow of need knowledge across stakeholders in an organization over time, using a multidimensional knowledge-flow model.

Need Knowledge Determinants

Data collected for this case study indicated three types of need knowledge: procurement, ERP, and authorizing. Procurement knowledge includes the mechanical procurement process itself (tacit), and the associated written procedures and guidelines (explicit) that direct the process. In this case study, the project-team stakeholder group

that executed and fulfilled the procurement process gained the procurement knowledge through training.

Procurement knowledge was not sufficient in fulfilling the procurement process, and by extension, did not complete the knowledge-flow loop. ERP knowledge was also critical in assessing the technical aspect of the bids submitted. The project-team stakeholder group did not have ERP knowledge, nor could they be quickly trained in this area to fulfill the procurement process. ERP knowledge was needed to understand what was being procured, and to assess the responsiveness of bidders against the system's technical specifications and functional requirements stated in the bid documents. The vendor stakeholder group, represented by the IVV consultancy team and the ministry's IS department, provided this type of need knowledge.

Throughout the preimplementation phase, two pivotal occasions arose when the flow of knowledge was stalled and only advanced when (a) the finance minister called for a review of the procurement process to assure compliance prior to progressing to the second stage of the procurement process, and (b) when the finance minister requested an assessment of continued relevance of the ERP system being procured before authorizing further processing. Findings from the review of procurement-process compliance and assessment of ERP-system relevance rendered the third type of need knowledge that authorized the advancement of knowledge flow. Top management, under consultation with the organization stakeholder group, possessed the authorizing need knowledge.

These three types of need knowledge can be extended and generalized into the concept of three need knowledge determinants—intrinsic, extrinsic, and catalytic—that enable knowledge-flow advancement. For this case study, procurement was considered

intrinsic need knowledge that is basic, general, procedural, how-to, domain-based knowledge without which no procurement process could emerge. Extrinsic need knowledge refers to technical and subject-matter- or industry-specific knowledge such as IT and ERP-related knowledge for this case study. All processes in an organization require some subject-matter- or industry-specific knowledge. Catalytic need knowledge is the authorizing environment to advance knowledge flow to the next point in space or time. Without the catalytic knowledge to authorize procurement-process advancement, as evidenced in this case study, the procurement knowledge loop would be incomplete. Catalytic knowledge enables *Ba* (Nonaka et al., 2000), or what Kaiser et al. (2014) referred to a "special kind of Ba," a "time-space-nexus" of "shared space" necessary to complete the need knowledge-flow loop.

Figure 6 depicts the three need knowledge determinants. Following the discussion thread in Chapter 4, stakeholder groups possessed different need knowledge determinants, and all three determinants are needed to enable completion of a knowledge-flow phenomenon. In Figure 6, stakeholder groups are not specified to reflect a generalized concept of the enabling aspect of the three need knowledge determinants in a knowledge-flow phenomenon. Different cases will have different stakeholder groups, but the three need knowledge determinants—intrinsic, extrinsic, and catalytic—are necessary in enabling knowledge-flow advancement. This enabling effect aligns with the Kaiser et al. (2014) definition for needs as requirements for an organization's sustainable existence. The next subsection considers the obstructing conditions introduced in Chapter 4.

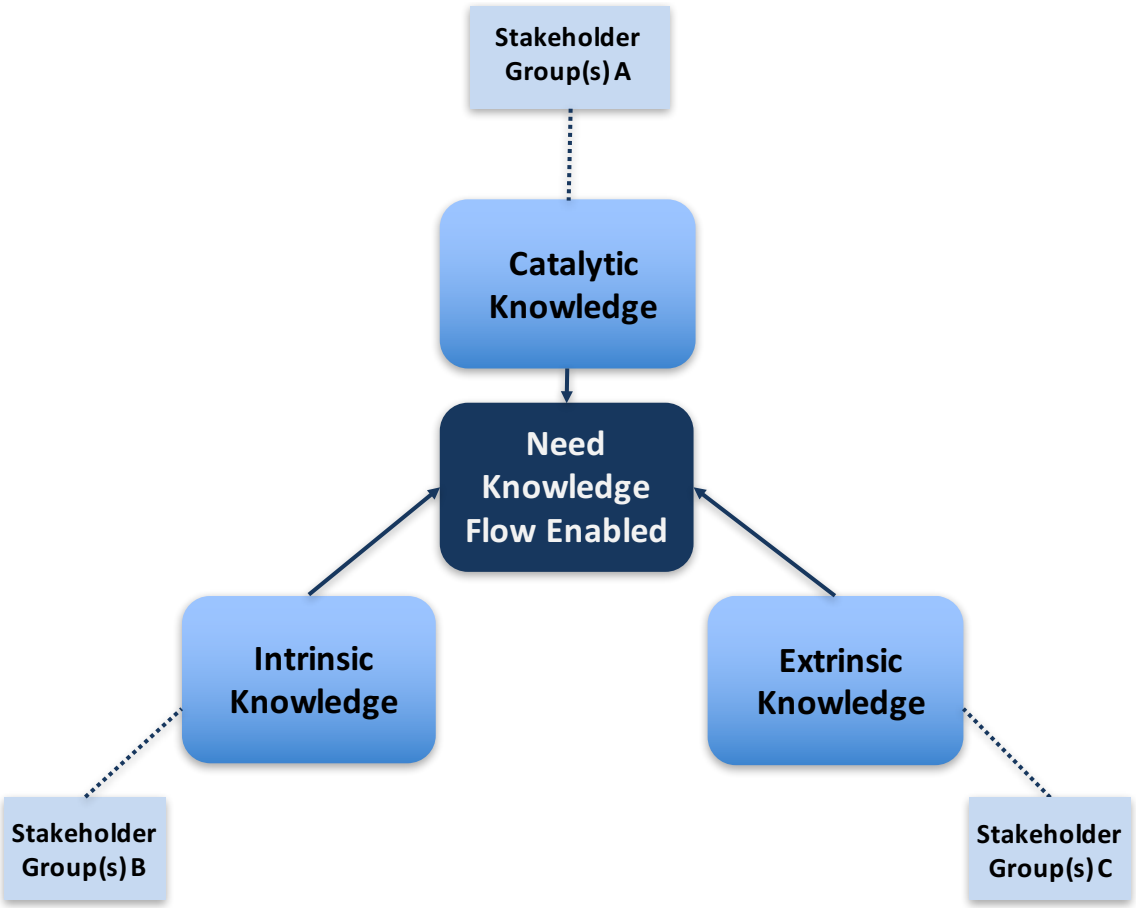

Figure 6. Need knowledge determinants in knowledge flow.

Explanations of the Knowledge-Flow Patterns

Nissen (2014) postulated two archetypical 5D knowledge-flow patterns that most organizations routinely employ as classic processes. Further, multiple permutations are possible for these archetypical knowledge-flow patterns and the "5D space enables one to understand, visualize and analyze every knowledge flow in any comprehensible organization" (Nissen, 2014, p. 81). In this subsection, Nissen's two archetypical 5D knowledge-flow patterns are adopted to explain need knowledge-flow patterns of this research case.

Following Nissen's (2014) designation, Knowledge-Flow 1 is a low-powered flow. For this case study, Knowledge-Flow 1 is characterized by procurement knowledge

(intrinsic need knowledge) first learned explicitly by the project-team stakeholder group through procurement training sessions, and ERP knowledge (extrinsic need knowledge), gained as inputs from the vendor and IS-department stakeholder groups. Knowledge continued to flow, converting from explicit (learning) to tacit (applying) knowledge on the explicitness dimension along the vertical y-axis of the Cartesian coordinate system described in Chapter 3, but flowing slowly from learning to applying (finalizing bids evaluation) on the life-cycle dimension along the z-axis that comes out of the page. The knowledge-flow loop was then completed quickly and powerfully, once catalytic need knowledge was acquired from the organization and top-management stakeholder groups, oscillating on the reach dimension along the x-axis, providing the authorizing environment for the project-team stakeholder group to complete the knowledge-flow loop by awarding the system-implementation contract. This knowledge-flow path took a circuitous 4.5 years and mostly on low power, meaning the knowledge-based action was weak.

The slow flow time and low-powered flow before the inflow of catalytic knowledge could be attributed to the three knowledge-flow obstructing conditions identified in this case study as resistance, peripatetic workforce, and organizational ownership. Throughout both stages of the bidding process, resistance, a sense of not able to process the procurement and being unwilling to embrace the ERP system, seemed to be the dominant obstructing condition among government stakeholder groups. A peripatetic workforce available to work on the procurement activities and the lack of commitment across stakeholder groups throughout the organization comprised the other two conditions that obstructed knowledge-flow advancement. Despite numerous

structured training sessions delivered by the IFI to the government project team, the IFI and government project teams felt they did not really have the need knowledge to finalize the procurement process. It took, eventually, an anonymous letter to the president of the IFI at its headquarters, alleging corrupt practice by the government project team to trigger organizational intervention by the finance ministry and the IFI, the former to demand assurance from government senior staff of no wrongdoing and the latter to conduct an investigation of IFI's internal-procurement practice, to generate catalytic need knowledge, thereby explicitly resetting the forward motion to complete the knowledge-flow loop. Tacit knowledge (intrinsic need knowledge such as general-procurement process and extrinsic need knowledge, ERP-related) is dilute, slow-moving, and less powerful than explicit knowledge (catalytic need knowledge in the form of IFI's investigative report) in this knowledge-flow pattern.

Knowledge-Flow 2 is high powered and associated primarily with tacit knowledge (catalytic need knowledge) acquired by an individual, who applies the knowledge and shares it with a small group of people through personal interactions, and across an organization through delegation or staff assignments. Tacit-knowledge conversion is slow in general, but once acquired is powerful, direct, and fast. During the second-stage bidding process, the embattled government procurement team dug in, insisting that only one bidder was qualified to win. It was the minister, representing the organization stakeholder group, who called for a review of the benefits and relevance of the ERP system to change the mindset of all stakeholder groups. By the time the bid opening took place, the relevance review was completed, reaffirming the relevance of the FMIS project. The minister then announced to all senior officers (directors-general level)

that the FMIS was critical to the ministry and should be implemented quickly, and the focus was to process the procurement. This was the catalytic need knowledge that was high powered, and moved fast and directly across the organization, enabling a knowledge-based action to complete the knowledge-flow loop.

The above discussion uses Nissen's (2014) 5D knowledge-flow model that espouses two archetypical knowledge flows to address the first prong of the research question by providing an explanation of how need knowledge flows across stakeholders in an organization over time. The explanation also addresses the second prong of the research question and merges two concepts identified in this case study. Three need knowledge determinants—intrinsic, extrinsic, and catalytic—enable knowledge flow. Three obstructing conditions—resistance, peripatetic workforce, and organizational ownership—hinder knowledge flow. This case study further postulates that the three need knowledge determinants and the three obstructing conditions are key ingredients in knowledge flow dynamics.

Limitations

This case study builds on existing work—knowledge-flow theory, need-knowledge generation, and the critical success factors for ERP implementation—to examine the multidimensional knowledge-flow phenomenon in context. Three sources of evidence accrued: project-related documentation, archival records, and interviews. The amount of data embedded in the project-related documentation and archival records, although mostly factual, stating "what happened" with minimal critical analysis on "why it happened," could have benefited from using some content-analysis software for more systematic and comprehensive data mining to better categorize factors that affected the

flow of need knowledge across stakeholder groups. In this study, "why it happened" was mostly addressed by interviews based on individual memories almost a decade old, with details likely to be selectively edited or otherwise corrupted by more recent events. However, with the successful launching of the FMIS and smooth operation of the system since 2015, interviewees seemed to be open and able to be critical in discussing their individual and organizational weaknesses. Furthermore, the explication of the three enabling need knowledge determinants and three obstructing conditions was grounded in established research streams. These two research artifacts of enabling need knowledge determinants and obstructing conditions can be considered analytic generalizations for knowledge-flow phenomena in an organization.

Implications

This case study proposes a new framework to explain knowledge-flow dynamics using Nissen's (2014) multidimensional knowledge-flow model. Nissen's (2014) model is further contextualized by the Kaiser et al.'s (2014) need knowledge focus and Nour and Mouakket's (2011) stakeholder groups in ERP implementation in the ERP CSF research stream. Based on this framework, this case study explained need knowledge flows across stakeholders in an organization over time. This case study postulated three need knowledge determinants—intrinsic, extrinsic, and catalytic—that enable knowledge flow, and three obstructing conditions—resistance, peripatetic workforce, and organizational ownership—that hinder knowledge flow. Given this tension between enabling and obstructing, this study suggests further insights into Nissen's (2014) 5D knowledge-flow principles described in Chapter 2:

1. The first principle relates to the innate inertia of knowledge. It follows that top-management actions lead knowledge-flow processes across an organization. The actor in this case was the minister, representing the organization stakeholder group, whose catalytic need knowledge was instrumental in providing the top-management stakeholder group with the enabling environment to lead the project team to fulfill the procurement process, which is to complete the knowledge-flow loop. This principle also relates most to the resistance condition in obstructing knowledge flow.
2. The second principle addresses the relationship between organizational workflows and knowledge flows. Changes to workflows must be followed by changes to knowledge flows and vice versa. The no-objection issuance process represents the experiential process that triggers the organizational workflow process (the doing). The government team initiated a request by submitting a bid-evaluation report and the IFI project team reviewed and issued a no-objection. The government team then had to rework the report through additional learning. These oscillating iterations effected educational processes (the learning) for both sides and in turn obstructed knowledge flows. Therefore, if the aim is to promote knowledge flows, it is important to understand how specific need knowledge flows relate to organizational workflows. Of the three obstructing conditions, resistance relates most to this principle.
3. The third principle states that knowledge flows parallel critical paths of workflows and therefore organizational performance. Accordingly, knowledge

flows should be managed like workflows. Throughout the procurement process, a collapse emerged along the critical paths of organizational processes, evidenced by insufficient and inefficient procurement training to gain intrinsic knowledge, the refusal to acquire ERP-related knowledge for extrinsic knowledge, and the delayed provision of the authorizing environment as catalytic knowledge toward procuring the ERP system or completing the knowledge-flow loop. The resistance condition contributes most to this principle.

4. The fourth principle brings in the temporal dimension on the sequencing of knowledge flows and workflows, indicating that knowledge flows need to complete their course before critical and dependent workflows can begin. The case study, through its numerous knowledge-workflow tributaries, provides a real-life model of this principle. In particular, the almost 2-year delay in the second-stage bidding process afforded the time horizon for a critical mass of government officials to reach the absorptive capacity to join with the project by explicating the technical and functional requirements to be included in the procurement of the FMIS. The peripatetic workforce relates to this principle.
5. The fifth knowledge-flow principle encapsulates the concept of knowledge power. Specifically, Nissen (2014) postulated that explicit knowledge flows quickly and broadly but with relatively diluted power, whereas tacit knowledge flows comparatively slowly and narrowly but at higher power. In this case study, explicit knowledge carried the highest and strongest power throughout. The successful completion of the procurement process relied

greatly on the minister explicitly issuing the need to proceed. Catalytic knowledge was instrumental in completing the procurement knowledge-flow loop, and organizational ownership plays into this principle.

The interplay of Nissen's (2014) five principles and the three conditions of knowledge-flow obstructions identified in the study provide just one view to demonstrate that this research addressed the research questions by introducing a theoretical framework to explain how need knowledge flows across stakeholders, while validating Nissen's (2014) 5D knowledge-flow model.

Recommendations

This single-case study was a postmortem analysis. The case itself proved to be an appropriate laboratory to study the multidimensionality of knowledge flow. Future work should focus on application aspects of the 5D knowledge flow, stakeholder dynamics, and associated need knowledge in the design of enterprise-wide initiatives. Given the lengthy procurements of most IFI-financed reform projects, future work could examine procurement as a profession, not unlike the audit profession discussed by Nguyen and Kohda (2017). Nguyen and Kohda introduced a 3-E model of wisdom determinants that encompassed the epistemic virtue, ethical virtue, and enabling virtue required in wise decision making in the audit profession. A procurement-evaluation process, accordingly, could be considered to explore the role of wisdom in judgment during the procurement-evaluation process and could potentially alleviate obstructing conditions. Furthermore, applying Kaiser's (2017) three-step theory wave to learn from an envisioned future as a prerequisite for any major enterprise-wide project could contribute to more sustainable transformative initiatives for organizations.

Summary

Knowledge is a sustainable advantage and knowledge assets can increase their value with use. This snowball effect of knowledge advantage advocates effective KM to foster its continual growth as it flows. Knowledge, however, flows unevenly throughout an organization and the problem is that the fundamental dynamics of these flows are still not well characterized in theoretical and computational models. This case study built on existing work—knowledge-flow theory, need knowledge generation, and critical success factors for ERP implementation—to present a theoretical framework to characterize knowledge-flow patterns by addressing a two-pronged research question: How can need knowledge and its flow across stakeholders in an organization over time be explained using a multidimensional knowledge-flow model and how can Nissen's (2014) 5D knowledge-flow model be validated using a real-life immersion case?

The first prong of the research question introduced the four elements—need knowledge, stakeholders, knowledge flow, and a multidimensional knowledge-flow model—in a knowledge-flow phenomenon. The second prong of the research question stipulates Nissen's (2014) 5D knowledge-flow model. The theoretical framework, depicted in Figure 2 in Chapter 3, therefore centers on Nissen's (2014) 5D knowledge-flow model that characterizes a particular knowledge flow in four dimensions—reach, explicitness, lifecycle, and flow time—and represents efficacy in achieving a knowledge-based action in the knowledge-power dimension. This multidimensional knowledge-flow model was extended to include the Kaiser et al. (2014) need knowledge designation and Nour and Mouakket's (2011) stakeholder-group classification in ERP implementation in the ERP CSF research stream. Specifying knowledge as need knowledge and identifying

stakeholder groups aligns with Jennex's (2008) effective KM by "getting the right knowledge to the right people at the right time" (p. 52).

This research followed Yin's (2014) case-study protocol and collected three sources of evidence: project-related documentation, archival records, and interviews. Project-related documentation included a project-consideration document, eight semiannual reports that included one midterm review, seven monitoring-mission reports, and one project-completion report. Archival records comprised 2,180 entries of mostly e-mails with attachments of formal correspondence, legal documents, and meeting minutes archived in the project portal. Interviewees were chosen to represent the five stakeholder groups (see Table 1 in Chapter 3) relevant to the preimplementation phase of the ERP project in this case study under Nour and Mouakket's (2011) classification: top management, information-systems department, project team, organization, and vendor.

The three sources of evidence were mutually corroborating. Analysis of the data collected yielded three results components: (a) a chronology of key events that obstructed knowledge flow was developed in Chapter 4; (b) a logic model depicting themes that contributed to knowledge-flow obstruction was described in Chapter 4; and (c) explanations of the knowledge-flow patterns for this case study were discussed in the early part of this chapter. The chronology was developed primarily based on project-related documentation and archival records, which were factual and contributed to the etic view of "what happened." The interviews provided the emic view of "why it happened." The chronology provided the context for the study of the interplay of need knowledge and stakeholder groups and how a multidimensional knowledge-flow model explained the knowledge-flow phenomenon. Nissen (2014) postulated that organizations

in general lack processes to support direct, quick, and powerful knowledge flow, resulting in obstructions along the knowledge-flow path. The logic model described by Yin (2014) was constructed as a tool to understand these knowledge-flow obstructions by deriving the cause–effect results chain.

The case study established three enabling need knowledge determinants: intrinsic, extrinsic, and catalytic. Intrinsic need knowledge refers to basic, general procedural how-to, domain-based knowledge. Extrinsic need knowledge denotes technical and subject-matter or industry-specific knowledge. Catalytic need knowledge is the authorizing environment to advance knowledge flow to the next point in space or time. Different stakeholder groups possess different need knowledge determinants, and all three determinants together are obligatory to complete a knowledge-flow loop. This case study also identified three obstructing conditions—resistance, peripatetic workforce, and organizational ownership—that could prevent need knowledge from flowing directly, quickly, and powerfully across stakeholders in an organization. In addition to using logic-model analysis in explaining the role of obstructions in the knowledge-flow phenomenon, Nissen's (2014) two archetypical 5D knowledge-flow patterns were used to understand and visualize the knowledge-flow paths of the case studied. Knowledge-Flow 1 is characterized as a low-powered, indirect, and slow flow, dominated by the three obstructing conditions. Knowledge-Flow 2 is characterized as high powered, with all three enabling need knowledge determinants at play.

This case study addressed the first prong of the research question by explaining how need knowledge flowed across stakeholders in an organization using Nissen's (2014) 5D knowledge-flow model. By explaining the flow of need knowledge using

Nissen's (2014) model, the study validated Nissen's model and addressed the second prong of the research question. The study also extended the model by introducing the concepts of need knowledge and stakeholder groups, and therefore was successful in achieving the goal of extending Nissen's (2014) 5D knowledge-flow model. The case study reinforced Nissen's (2014) five knowledge-flow principles except the fifth one, whereby Nissen asserted that explicit knowledge flows quickly and broadly but with relatively diluted power. This case study provided an exception that explicit knowledge carried the highest and strongest power throughout its life.

Future work could view procurement as a profession and explore the role of wisdom in judgment during the procurement-evaluation process. Incorporating envisioning or learning from the future as a prerequisite to embark on any major enterprise-wide transformative initiative could contribute to sustained results. Last, the three need knowledge determinants and three obstructing conditions identified in this study are key ingredients in knowledge-flow dynamics. These two research artifacts should be considered as one unit to provide a fresh research avenue to better understand knowledge-flow dynamics.

Appendix A: Interview Protocol

Date of Interview:
Time of Interview:
Venue:
Interviewer:
Interviewee:
Role in the Project:
Time Frame Involved in the Project:

Questions:

Due to the semi-structured nature of the interview, the interviewer may probe and ask for expansion or clarification of topics.

> Tell me about your experience with the project. I'm interested in the period up to the contract signing of contract for the FMIS.

The interviewer will use probing questions to keep the interviewee's thoughts flowing. Questions such as the following could be asked.

1. What were your experiences? Did you feel equipped with the right information or knowledge to do your tasks? Please explain.
2. Who were your main counterparts, both internal & external, in project, specifically the FMIS component of the project?
3. How did you communicate amongst the different individuals and groups over the period up to the FMIS contract was signed? Was there any change over time?
4. What was your first impression of the project? Was there any change in that impression during your tenure with the project?
5. If you had the opportunity to start again, is there anything you would do differently? What advice do you wish given at the beginning when you joined the project?

Thank so much for participating in this interview. Your responses are confidential.

Source: Derived from Qualitative inquiry and research design: Choosing among five approaches, by J. W. Creswell, 2013, Thousand Oaks, CA: Sage.

Appendix B: IRB Memorandum of Approval

NOVA SOUTHEASTERN UNIVERSITY
Institutional Review Board

MEMORANDUM

To: **Lina Lo**
College of Engineering and Computing

From: **Ling Wang, Ph.D.,**
Center Representative, Institutional Review Board

Date: **September 12, 2016**

Re: **IRB #: 2016-391; Title, "Understanding Knowledge Flow Dynamics During the Preimplementation Phase of an Enterprise Resource Planning Project"**

I have reviewed the above-referenced research protocol at the center level. Based on the information provided, I have determined that this study is exempt from further IRB review under **45 CFR 46.101(b) (Exempt Category 2)**. You may proceed with your study as described to the IRB. As principal investigator, you must adhere to the following requirements:

1) CONSENT: If recruitment procedures include consent forms, they must be obtained in such a manner that they are clearly understood by the subjects and the process affords subjects the opportunity to ask questions, obtain detailed answers from those directly involved in the research, and have sufficient time to consider their participation after they have been provided this information. The subjects must be given a copy of the signed consent document, and a copy must be placed in a secure file separate from de-identified participant information. Record of informed consent must be retained for a minimum of three years from the conclusion of the study.

2) ADVERSE EVENTS/UNANTICIPATED PROBLEMS: The principal investigator is required to notify the IRB chair and me (954-262-5369 and Ling Wang, Ph.D., respectively) of any adverse reactions or unanticipated events that may develop as a result of this study. Reactions or events may include, but are not limited to, injury, depression as a result of participation in the study, life-threatening situation, death, or loss of confidentiality/anonymity of subject. Approval may be withdrawn if the problem is serious.

3) AMENDMENTS: Any changes in the study (e.g., procedures, number or types of subjects, consent forms, investigators, etc.) must be approved by the IRB prior to implementation. Please be advised that changes in a study may require further review depending on the nature of the change. Please contact me with any questions regarding amendments or changes to your study.

The NSU IRB is in compliance with the requirements for the protection of human subjects prescribed in Part 46 of Title 45 of the Code of Federal Regulations (45 CFR 46) revised June 18, 1991.

Cc: **Timothy J Ellis, Ph.D.**

3301 College Avenue • Fort Lauderdale, Florida 33314-7796
(954) 262-0000 • 800-672-7223, ext. 5369 • Email: *irb@nova.edu* • Web site: www.nova.edu/irb

Appendix C: Letter Requesting Study Participation

Dear *[Name of Participant]*,

Thank you very much for your initial agreement to participate in my doctoral dissertation research at Nova Southeastern University. I am therefore sending you this written request. As discussed, the goal of the research, entitled *Understanding Knowledge Flow Dynamics During the Preimplementation Phase of an Enterprise Resource Planning Project*, is to use a case-study approach to better understand how knowledge flows across different stakeholders of an organization. The research will demonstrate how a multidimensional knowledge-flow model can be used to explain knowledge flows in a real-life case.

I would like to interview you on your experience in a recent financial management information system (FMIS) implementation. Your insights would be extremely beneficial in capturing lessons for future similar initiatives. Your identity will be kept completely confidential and your participation is on a totally voluntary basis. To further ensure confidentiality, the name of the country and the actual project name of this case study will not appear in the dissertation report. The interview will be no more than 2 hours. Please confirm that *[date, time]* at *[venue]* is still convenient for you.

If you agree to participate, please review and sign the attached Informed Consent Form and return a scanned copy to me by email before our interview session. Alternatively, you can review and sign the Form at the beginning of our interview session.

Please note that this research has been approved by the Institutional Review Board (IRB) at Nova Southeastern University. The IRB has the responsibility to ensure that all academic research conducted at Nova Southeastern University is conducted in an ethical manner respecting the rights of all participants.

Sincerely,

Lina Lo
Doctoral Candidate
Nova Southeastern University

Appendix D: Informed-Consent Form

Description of the Study

This research, entitled *Understanding Knowledge Flow Dynamics During the Preimplementation Phase of an Enterprise Resource Planning Project*, aims to better understand how knowledge flows across different stakeholders of an organization using a case-study approach. The research will demonstrate how a multidimensional knowledge-flow model can be used to explain knowledge flows in a real-life case.

Expectations

The interview will be no more than 2 hours focusing on your experience during the procurement period of a recent financial management information system (FMIS) implementation using a commercial off-the-shelf ERP system. Your identity will be kept completely confidential and your participation is on a totally voluntary basis. To further ensure confidentiality, the name of the country and the actual project name of this case study will not appear in the dissertation report. Once all interviews are completed and data organized or tabulated in a logical frame, you will receive a copy of this for review and further clarification if necessary. Therefore, a follow-up interview may result. If you wish, you can receive an electronic copy of the dissertation report when it becomes available.

Risk and Benefit to the Participant

There is no known risk associated with your participation in this study.

Voluntary Consent by Participant
By signing below you indicate that:

- This study has been explained to you.
- You have read this document or it has been read to you.
- Your questions about this research study have been answered.
- You have been told that you may ask the researcher any study-related questions in the future or contact the researcher in the event of research-related injury.
- You have been told that you may ask the Institutional Review Board (IRB) personal questions about your study rights.
- You are entitled to a copy of this form after you have read and signed it that you voluntarily agree to participate in the study entitled *Understanding Knowledge Flow Dynamics During the Preimplementation Phase of an Enterprise Resource Planning Project*

Participant's Signature	Date
_____	_____
Researcher's Signature	Date
_____	_____

Questions/Stakeholders & Their Roles	Organization *Consults*	Vendor *Consults*	IS Department *Supports*	Project Team *Fulfills*	Top management *Authorizes*
What were your *experiences*? Did you feel equipped with the right knowledge to do your tasks?	Pivotal for the government to decide whether to continue with the FMIS implementation was the evaluation conducted in 2007/2008; the evaluation was to determine whether the system was still relevant to the ministry. For the IFI, there were limited completed FMIS-type of implementations in 2004. Procurements of such systems were also uncharted in 2004.	The government and the IFI teams could not agree on bid-evaluation decisions. The government and the IVV teams also could not agree on bid-evaluation decisions.	The department was to manage/ provide IT infrastructure for the entire finance ministry, but was marginalized as each directorate-general had its own IT unit.	The 2-stage procurement process was new to all concerned in 2004. Procurement training sessions did not really help in evaluating bids received. Both project teams were keen to fulfill their duties	REPFMP was over designed and the staff had no sufficient experience to cope with its scope and size. The lack of change management meant that there was no public awareness campaign, and insufficient seminars or workshop gatherings to exchange knowledge and to provide support and reinforce ownership. The procurement process was so rigid that once the procurement process started, there was no opportunity to adjust requirements. The government structure was not conducive to project implementation, with no dedicated unit/team to work on the bid documents resulting in lack of ownership and adequate understanding of the document. The first IFI team leader had run-ins with the government teams that cast a long shadow throughout the preimplementation period.

Questions/Stakeholders & Their Roles	Organization *Consults*	Vendor *Consults*	IS Department *Supports*	Project Team *Fulfills*	Top management *Authorizes*
Who were your *main counterparts*, both internal and external?	The minister communicated mostly with the IFI team leader and occasionally with the country head of the IFI.	Government project team	The minister and government project team	The government and IFI project teams were each other's counterparts.	All the other stakeholder groups except for the IS department.
How did you communicate, exchange/*share knowledge*, or first know about anything amongst the different individuals and groups?	Mostly through meetings, especially those scheduled during IFI's semiannual monitoring missions. When issues arose, such as complaints, the minister issued formal letter to the president of the IFI at its HQ.	The IVV team developed evaluation templates and conducted training sessions to the government project and procurement teams on how to use the templates.	Through formal and informal meetings.	Through formal and informal meetings, supplemented by the no-objection process of the government team issuing letters and IFI responding by no-objection letters, which mostly, in reality, conditional no-objections. These no-objection cycles could go for a number of iterations.	Through meetings primarily.

Questions/Stakeholders & Their Roles	Organization *Consults*	Vendor *Consults*	IS Department *Supports*	Project Team *Fulfills*	Top management *Authorizes*
What were the *key stumbling blocks* and how were these resolved?	Noting resistance, as identified in Figure 4 and Table 3, the minister ordered an evaluation in late 2007/early 2008 to determine whether the FMIS was still relevant to the ministry. Evaluation results pointed to psychological problem with the first IFI team leader, and resistance identified above. From the IFI side, the FMIS implementation and procurement process were new with limited lessons to draw from.	Government staff working on the REPFMP had to attend to their day-to-day ministerial duties. Evaluation of the bids was only possible conducted off-site. Officials were "sequestered" in a hotel for multiple days to weeks to focus on bids evaluation. In addition, there was constant rotation of staff and absenteeism. It took almost one year to stabilize the procurement team of about 20 regulars. Another good practice that developed toward the end of the procurement period was the Tuesday meetings when relevant team members would meet. These meetings continued throughout the life of the FMIS project.	In order to bring the two dissenting groups—directorate-general of treasury and directorate-general of budget—together, weekly Tuesday meetings were instigated and were attended by Echelon 2s, which comprised 12 directors from the directorate-general of treasury and the secretary to the directorate-general of treasury, 1 director from the directorate-general of budget, as well as the IS department.	At the end, key stumbling blocks were resolved by the minister to move procurement impasses forward to the next stage.	REPFMP was over designed, amongst other external circumstances including a major natural disaster, ongoing organizational restructuring of the finance ministry, newly enacted public-finance management legal instruments aimed to mitigate institutionalized corrupt practices, and the lack of chart of accounts. In addition, the two directorates general, treasury and budget, could not see eye-to-eye.

Questions/Stakeholders & Their Roles	Organization *Consults*	Vendor *Consults*	IS Department *Supports*	Project Team *Fulfills*	Top management *Authorizes*
What would you *do differently* if you had the opportunity to start again?	Staff need to be convinced that the system is important to them and it is important to appoint a reform-minded champion. Comprehensive FMIS projects are best designed as a separate project and not mixed with other complex public financial management reform activities. Within the project team, there should be a technical specialist with hands-in and experience in system development to review the functional and technical requirements and provide quality assurance support on system design and the bid document.	Should insist on dedicated resources with team members who have no other duties than those related to the FMIS project.	There was a lack of ownership with the bid document as it was developed by consultants with limited discussions with the government teams. It would have been better to spend time upfront in developing the ERP system by the government. Would also be good to incorporate "story-telling" sessions by potential suppliers/vendors for the ministry to better understand the solutions proposed by the suppliers/vendors.	At the onset, build trust, build support, drive momentum, and broaden stakeholder base to take into account the broader stakeholder view. Change management should be in place early on.	Should roll out change management from the beginning.

	Resistance		Peripatetic workforce	Ownership	
Dimensions /Themes	Not able	Not willing	Lack of resources	Not knowing	Lack of support
Reach	Formal training sessions on procurement were delivered by the IFI to the potential government procurement teams prior to the FMIS procurement activities started. (*Source: interviews; IFI reports*) However, most of those attended the training were rotated out to other posts by the time FMIS procurement activities started. In contrast, there was not much training across the IFI stakeholder groups. (*Source: interviews)*	There was not much support of the REPFMP outside of the directorate-general of treasury. (*Source: interviews; government monitoring reports*)	Decisions at key stages of the procurement process reached across all five stakeholder groups. (*Source: interviews; government monitoring report; archival records*)	Knowledge of the REPFMP would have reached multiple stakeholders if the change-management and communications consultancy, one of the effectiveness conditions, was in place, but it was not during the study period due primarily to underestimation of the cost of the consultancy. (*Source: interviews; government and IFI monitoring reports; archival records*)	Need knowledge to complete the procurement process flowed narrowly and did not reach all stakeholders. (*Source: interviews; government and IFI monitoring reports*)

Dimensions /Themes	Resistance		Peripatetic workforce	Ownership	
	Not able	Not willing	Lack of resources	Not knowing	Lack of support
Explicitness	Training sessions were theory-based and lack of situational problem-solving simulation. (*Source: interviews*)	The key procurement document was the bid document, which was finalized by a government-hired consultancy. The consultancy more or less prepared the document on their own, with limited consultation with stakeholder groups resulting in a piece of explicit knowledge with limited ownership. Furthermore, this explicit knowledge product did not convert fully all the tacit knowledge. (*Source: interviews*)	During the bid evaluation, tacit knowledge was converted into explicit knowledge through the write-up of the bid evaluation reports. (*Source: IFI and government monitoring reports; archival records*)	Before any loan agreements, the IFI would prepare and release to the public project consideration documents of the to-be financed projects. These documents cover the context, rationale, design, scope, timeline, implementation approaches, expected results, associated costs, and loan amounts. (*Source: project consideration document*) The government stakeholders did not understand well the REPFMP consideration document. (*Source: interviews*)	Explicit knowledge did not flow broadly in this case study with the exception of the minister's explicit actions to move the procurement process forward. (*Source: interviews; IFI monitoring reports*)

	Resistance		Peripatetic workforce	Ownership	
Dimensions/Themes	Not able	Not willing	Lack of resources	Not knowing	Lack of support
Lifecycle	While most involved in the REPFMP within the government side were pessimistic throughout, the preimplementation phase of the FMIS was completed with signing of the implementation contract. (*Source: interviews*)	The bid document underwent multiple knowledge conversion processes and at the end served its objective of completing the procurement cycle, which in turn the knowledge lifecycle. (*Source: government and IFI monitoring reports; interviews*)	The bid evaluation process exemplified full knowledge lifecycle from creation, to organize, to formalize, to share, to apply. (*Source: monitoring reports; interviews; archival records*)	Knowledge of the REPFMP as a project did not actually complete the knowledge lifecycle during the study period. (*Source: monitoring reports*)	New IFI procurement knowledge was rolled out, but with limited applications to learn from resulting in an incomplete lifecycle. (*Source: interviews*)
Time	Procurement knowledge flow time was long. (*Source: interviews; IFI and government monitoring reports; archival records*)	The knowledge flow under this theme took a long time. (*Source: interviews; government monitoring reports*)	The knowledge flow under this theme took a long time, including multiple reworks. (*Source: interviews; government monitoring reports*)	Knowledge of the REPFMP took a long flow time. (*Source: interviews; IFI monitoring reports*)	Need knowledge flow under this theme took a long time. (*Source: interviews; government monitoring reports*)
Power	With the procurement knowledge resulted in the signing of the FMIS implementation contract, the procurement knowledge power was strong for this case study. (*Source: all 3*)	With the procurement completed, the knowledge power under this theme was strong. (*Source: all 3*)	With the procurement completed, the knowledge power under this theme was strong. (*Source: all 3*)	Knowledge of the REPFMP did not flow broadly, which greatly stymied the associated knowledge power. (*Source: all 3*)	With the procurement completed, the knowledge power under this theme can be considered as strong. (*Source: all 3*)

References

Alves, M. C., & Matos, S. I. A. (2013). ERP adoption by public and private organizations—A comparative analysis of successful implementations. *Journal of Business Economics and Management, 14,* 500–519. doi:10.3846/16111699.2011.652979

Anand, A., & Walsh, I. (2016). Should knowledge be shared generously? Tracing insights from past to present and describing a model. *Journal of Knowledge Management, 20,* 713–730. doi:10.1108/JKM-10-2015-0401

Ayas, K., & Zeniuk, N. (2001). Project based-learning: Building communities of reflective practitioners. *Management Learning, 32,* 61–76. doi:10.1177/1350507601321005

Bartolacci, C., Cristalli, C., Isidori, D., & Niccolini, F. (2016). *Ba* virtual and inter-organizational evolution: A case study from a EU research project. *Journal of Knowledge Management, 20,* 793–811. doi:10.1108/JKM-09-2015-0342

Burberry, P. (1997). *Mitchell's environment & services*. Essex, England: Longman.

Cavaliere, V., & Lombardi, S. (2015). Exploring different cultural configurations: How do they affect subsidiaries' knowledge sharing behaviors? *Journal of Knowledge Management, 19,* 141–163. doi:10.1108/JKM-04-2014-0167

Chan, E. W. L., Walker, D. H. T., & Mills, A. (2009). Using a KM framework to evaluate an ERP system implementation. *Journal of Knowledge Management, 13,* 93–109. doi:10.1108/13673270910942727

Coradi, A., Heinzen, M., & Boutellier, R. (2015). Designing workspaces for cross-functional knowledge-sharing in R&D: The "co-location pilot" of Novartis. *Journal of Knowledge Management, 19,* 236–256. doi:10.1108/JKM-06-2014-0234

Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). Thousand Oaks, CA: Sage.

Davenport, T. H., & Prusak, L. (2000). *Working knowledge: How organizations manage what they know*. Boston, MA: Harvard Business School Press.

Dawson, J., & Owens, J. (2008). Critical success factors in the chartering phase: A case study of an ERP implementation. *International Journal of Enterprise Information Systems, 4*(3), 9–24. doi:10.4018/jeis.2008070102

Dener, C., Watkins, J. A., & Dorotinsky, W. L. (2011). *Financial management information systems: 25 years of World Bank experience on what works and what doesn't.* Washington, DC: The World Bank.

Dezdar, S., & Sulaiman, A. (2009). Successful enterprise resource planning implementation: Taxonomy of critical factors. *Industrial Management & Data Systems, 109,* 1037–1052. doi:10.1108/02635570910991283

Diamond, J., & Khemani, P. (2005). *Introducing financing management information systems in developing countries* (Working Paper WP/05/196). Washington, DC: International Monetary Fund.

Dittes, S., & Smolnik, S. (2016). Is it an antecedent? Is it an outcome? No, it's culture! Understanding the relationship between cultural values and the use of information systems fostering collaboration. In T. X. Bui & R. H. Sprague, Jr. (Eds.), *Proceedings of the 49th Hawaii International Conference on System Sciences* (pp. 4213–4222). Los Alamitos, CA: Institute of Electrical and Electronics Engineers Computer Society. doi:10.1109/HICSS.2016.523

Floropoulos, J., Spathis, C., Halvatzis, D., & Tsipouridou, M. (2010). Measuring the success of the Greek Taxation Information System. *International Journal of Information Management, 30,* 47–56. doi:10.1016/j.ijinfomgt.2009.03.013

Fotini, M., Anthi-Maria, S., & Euripidis, L. (2008). ERP systems business value: A critical review of empirical literature. In *Panhellenic Conference on Informatics* (pp. 186–190). New York, NY: IEEE. doi:1109/PCI.2008.38

Gauld, R. (2007). Public sector information system project failures: Lessons from a New Zealand hospital organization. *Government Information Quarterly, 24,* 102–114. doi:10.1016/j.giq.2006.02.010

Georgakopoulos, D., Hornick, M., & Sheth, A. (1995) An overview of workflow management: From process modeling to workflow automation infrastructure. *Distributed and Parallel Databases, 3,* 119–153. doi:10.1007/BF01277643

Goh, S. C. & Ryan, P. J. (2008). The organizational performance of learning companies: A longitudinal and competitor analysis using market and accounting financial data. *Learning Organization, 15,* 225–239. doi:10.1108/09696470810868855

Guo, Y., Feng, Y., & Wang, C. (2014). The impact mechanism of organizational culture on ERP assimilation: A multi-case study. In R. H. Sprague, Jr. (Ed.), *Proceedings of the 47th Hawaii International Conference on System Sciences* (pp. 4044–4053). Los Alamitos, CA: Institute of Electrical and Electronics Engineers Computer Society. doi:10.1109/HICSS.2014.500

Haas, M. R., & Hansen, M. T. (2005). When using knowledge can hurt performance: The value of organizational capabilities in a management consulting company. *Strategic Management Journal, 26*, 1–24. doi:10.1002/smj.429

Hafner, J. H. (2016). Does incomplete unlearning impact medical errors? In T. X. Bui & R. H. Sprague, Jr. (Eds.), *Proceedings of the 49th Hawaii International Conference on System Sciences* (pp. 4324–4330). Los Alamitos, CA: Institute of Electrical and Electronics Engineers Computer Society. doi:10.1109/HICSS.2016.537

Hanafizadeh, P., Gholami, R., Dadbin, S., & Standage, N. (2010). The core critical success factors in implementation of enterprise resource planning systems. *International Journal of Enterprise Information Systems, 6*(2), 82–111. doi:10.4018/jeis.2010040105

Hanisch, B., Lindner, F., Mueller, A., & Wald, A. (2009). Knowledge management in project environments. *Journal of Knowledge Management, 13,* 148–160. doi:10.1108/13673270910971897

Holford, W. D. (2016). Managerial implications on viewing knowledge as constructions. In T. X. Bui & R. H. Sprague, Jr. (Eds.), *Proceedings of the 49th Hawaii International Conference on System Sciences* (pp. 4154–4162). Los Alamitos, CA: Institute of Electrical and Electronics Engineers Computer Society. doi:10.1109/HICSS.2016.515

Holten, A. Hancock, G., Persson, R., Hansen, A. & Hogh, A. (2016). Knowledge hoarding: antecedent or consequent of negative acts? The mediating role of trust and justice. *Journal of Knowledge Management, 20,* 215–229. doi:10.1108/JKM-06-2015-0222

Ingram, C., & Morisse, M. (2016). Almost an MNC: Bitcoin entrepreneurs' use of collective resources and decoupling to build legitimacy. In T. X. Bui & R. H. Sprague, Jr. (Eds.), *Proceedings of the 49th Hawaii International Conference on System Sciences* (pp. 4093-4092). Los Alamitos, CA: Institute of Electrical and Electronics Engineers Computer Society. doi:10.1009/HICSS.2016.507

Inouye, T. M. (2016). Militarization as a socio-political context for entrepreneurial innovation. In *Proceedings of the 49th Hawaii International Conference on System Sciences* (pp. 4093–4102). Los Alamitos, CA: Institute of Electrical and Electronics Engineers Computer Society. doi:10.1109/HICSS.2016.508

Israilidis, J., Siachou, E., Cooke, & Lock, R. (2015). Individual variables with an impact on knowledge sharing: the critical role of employees' ignorance. *Journal of Knowledge Management, 19,* 1109–1123. doi:10.1108/JKM-04-2015-0153

Jeng, D. J-F., & Dunk, N. (2013). Knowledge management enablers and knowledge creation in ERP systems success. *International Journal of Electronic Business Management, 11,* 49–59.

Jennex, M. E. (2008). Impacts from using knowledge: A longitudinal study from a nuclear power plant. *International Journal of Knowledge Management, 4,* 51–64. doi:10.4018/jkm.2008010105

Jennex, M. E., & Croasdell, D. T. (2016). Knowledge Innovation and Entrepreneurial Systems Track Introduction. In T. X. Bui & R. H. Sprague, Jr. (Eds.), *Proceedings of the 49th Hawaii International Conference on System Sciences* (p. 4009). Los Alamitos, CA: Institute of Electrical and Electronics Engineers Computer Society. doi:10.1109/HICSS.2016.496

Jones, M. C., Cline, M., & Ryan, S. (2006). Exploring knowledge sharing in ERP implementation: An organizational culture framework. *Decision Support Systems, 41,* 411–434. doi:10.1016/j.dss.2004.06.017

Jugdev, K. (2007). Closing the circle: The KM spiral of project management. *International Journal of Knowledge Management Studies, 1*(3/4), 423–441. doi: 10.1504/IJKMS.2007.012533

Kaiser, A. (2017). Towards a knowledge-based theory of developing sustainable visions: The theory wave. In *Proceedings of the 50th Hawaii International Conference on System Sciences* (pp. 4495–4504). Los Alamitos, CA: Institute of Electrical and Electronics Engineers Computer Society. doi:10.24251/HICSS.2017.545

Kaiser, A., Fordinal, B., & Kragulj, F. (2014). Creation of need knowledge in organizations: An abductive framework. In R. H. Sprague, Jr. (Ed.), *Proceedings of the 47th Hawaii International Conference on System Science Proceedings* (pp. 3499–3508). Los Alamitos, CA: Institute of Electrical and Electronics Engineers Computer Society. doi:10.1109/HICSS.2014.436

Kamhawi, E. M. (2007). Critical factors for implementation success of ERP systems: An empirical investigation from Bahrain. *International Journal of Enterprise Information Systems, 3*(2), 34–49. doi:10.4018/jeis.2007040103

Kanthawongs, P., & Kanthawongs, P. (2011). Cultural dimensions affecting user satisfaction of ERP systems for a developing country. *Review of Business Research, 11*(4), 107–111.

Khattak, M. A. O., She, Y., Memon, Z. A., Syed, N., Hussain, S., & Irfan, M. (2013). Investigating critical success factors affecting ERP implementation in Chinese and Pakistani enterprises. *International Journal of Enterprise Information Systems, 9*(3), 39–76. doi:10.4018/jeis.2013070103

Kianto, A., Vanhala, M., & Heilmann, P. (2016). The impact of knowledge management on job satisfaction. *Journal of Knowledge Management, 20,* 621–636. doi:10.1108 /JKM-10-2015-0398

Kim, Y., Hau, Y. S., Song, S., & Ghim, G. (2013). Trailing organizational knowledge paths through social network lens: Integrating the multiple industry cases. *Journal of Knowledge Management, 18,* 38–51. doi:10.1108/JKM-06-2013-0237

Klafke, R. V., Helmann, C. L., Picinin, C. T., de Francisco, A. C., & Pilatti, L. A. (2016). Primary knowledge management practices applied to Brazil, Russia, India and China (BRIC) industries from 2001–2010. *Journal of Knowledge Management, 20,* 812–828. doi:10.1108/JKM-12-2015-0522

Kumar, N. (2013). Managing reverse knowledge flow in multinational corporations. *Journal of Knowledge Management, 17,* 695–708. doi:10.1108/JKM-02-2013-0062

Lawson-Body, A., Willoughby, L., Mukankusi, L., & Logossah, K. (2011). The critical success factors for public sector CRM implementation. *The Journal of Computer Information Systems, 52*(2), 42–50. doi:10.1080/08874417.2011.11645539

Li, J., Yuan, Ning, L., & Li-Ying, J. (2015). Knowledge sharing and affective commitment: the mediating role of psychological ownership. *Journal of Knowledge Management, 19,* 1146–1166. doi:10.1108/JKM-01-2015-0043

Lin, C., Wu, J., & Tsai, H. (2013). A hybrid approach to knowledge flow. *Industrial Management & Data Systems, 113,* 628–646. doi:10.1108/02635571311324115

Lin, S., & Lo, L. Y. (2015). Mechanisms to motivate knowledge sharing: Integrating the reward systems and social network perspectives. *Journal of Knowledge Management, 19,* 212–235. doi:10.1108/JKM-05-2014-0209

Liu, P. (2011). Empirical study on influence of critical success factors on ERP knowledge management on management performance in high-tech industries in Taiwan. *Expert Systems with Applications, 38,* 10696–10704. doi:10.1016/j.eswa.2011.02.045

Macmillan, S., Steel, J., Austin, S., Kirby, P., & Spence, R. (2001). Development and verification of a generic framework for conceptual deign. *Design Studies, 22*, 169–191. doi:10.1016/S0142-694X(00)00025-9

Mahmood, A., Qureshi, A., & Evans, N. (2015). Deterrents to knowledge-sharing in the pharmaceutical industry: A case study. *Journal of Knowledge Management, 19,* 296–314. doi:10.1108/JKM-09-2014-0391

Martin-Perez, V., & Martin-Cruz, N. (2015). The mediating role of affective commitment in the rewards—knowledge transfer relation. *Journal of Knowledge Management, 19,* 1167–1185. doi:10.1108/JKM-03-2015-0114

McGinnis, T. C., & Huang, Z. (2007). Rethinking ERP success: A new perspective from knowledge management and continuous improvement. *Information & Management, 44,* 626–634. doi:10.1016/j.im.2007.05.006

McIver, D., & Wang, X. (2016). Measuring knowledge in organizations: a knowledge-in-practice approach. *Journal of Knowledge Management, 20,* 637–652. doi:10.1108/JKM-11-2015-0478

Nah, F. F-H., Lau, J. L-S., & Kuang, J. (2001). Critical factors for successful implementation of enterprise systems. *Business Process Management Journal, 7,* 285–296. doi:10.1008/14637150110392782

Negi, T. & Bansal, V. (2013). A methodology to bridge information gap in ERP implementation life cycle. *International Journal of Enterprise Information Systems, 9*(2), 70–82. doi:10.4018/jeis.2013040104

Ngai, E. W. T., Law, C. C. H., & Wat, F. K. T. (2008). Examining the critical success factors in the adoption of enterprise resource planning. *Computers in Industry, 59,* 548–564. doi:10.1016/j.compind.2007.12.001

Nguyen, L., & Kohda, Y. (2017). Toward a model of wisdom determinants in the auditing profession. In *Proceedings of the 50th Hawaii International Conference on System Sciences* (pp. 4604–4613). Los Alamitos, CA: Institute of Electrical and Electronics Engineers Computer Society. Retrieved from https://scholarspace.manoa.hawaii.edu/bitstream/10125/41722/1/paper0573.pdf

Nissen, M. E. (2002). An extended model of knowledge-flow dynamics. *Communications of the Association for Information Systems, 8*, 251–266.

Nissen, M. E. (2006a). Dynamic knowledge patterns to inform design: A field study of knowledge stocks and flows in an extreme organization. *Journal of Management Information Systems, 22*(3), 225–263. doi:10.2753/MIS0742-1222220308

Nissen, M. E. (2006b). *Harnessing knowledge dynamics: Principled organizational knowledge and learning.* Hershey, PA: IRM Press.

Nissen, M. E. (2014). *Harnessing dynamic knowledge principles in the technology-driven world.* Hershey, PA: IGI Global.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science, 5,* 14–37. doi:10.1287/orsc.5.1.14

Nonaka, I., Toyama, R., & Konno, N. (2000). SECI, *Ba* and leadership: A unified model of dynamic knowledge creation. *Long Range Planning, 33,* 5–34. doi:10.1016/S0024-6301(99)00115-6

Nour, M. A., & Mouakket, S. (2011). A classification framework of critical success factors for ERP systems implementation: A multi-stakeholder perspective. *International Journal of Enterprise Information Systems, 7*(1), 56–71. doi:10.4018/jeis.2011010104

O'Leary, D. E. (2002). Knowledge management across the enterprise resource planning systems life cycle. *International Journal of Accounting Information Systems, 3,* 99–110. doi:10.1016/S1467-0895(02)00038-6

Palanisamy, R. (2008). Organizational culture and knowledge management in ERP implementation: An empirical study. *The Journal of Computer Information Systems, 48*(2), 100–120. doi:10.1080/08874417.2008.11646013

Poon, P., & Yu, Y. T. (2010). Investigating ERP systems procurement practice: Hong Kong and Australian experiences. *Information and Software Technology, 52,* 1011–1022. doi:10.1016/j.infsof.2010.04.003

Pourzolfaghar, Z., Ibrahim, R., Abdullah, R., Adam, N. M., & Ali, A. A. A. (2013). Improving dynamic knowledge movements with a knowledge-based framework during conceptual design of a green building project. *International Journal of Knowledge Management, 9,* 62–79. doi:10.4018/jkm.2013040104

Remus, U. (2012). Exploring the dynamics behind knowledge management challenges—An enterprise resource planning case study. *Information Systems Management, 29*(3), 188–200. doi:10.1080/10580530.2012.687309

Rutten, W., Blaas-Franken, J., & Martin, H. (2016). The impact of (low) trust on knowledge sharing. *Journal of Knowledge Management, 20,* 199–211. doi:10.1108/JKM-10-2015-0391

Sedera, D., & Gable, G. (2010). Knowledge management competence for enterprise system success. *The Journal of Strategic Information Systems, 19,* 296–306. doi: 10.1016/j.jsis.2010.10.001

Serenko, A., & Bontis, N. (2016). Negotiate, reciprocate, or cooperate? The impact of exchange modes on inter-employee knowledge sharing. *Journal of Knowledge Management, 20,* 687–712. doi:10.1108/JKM-10-2015-0394

Serenko, A., & Dumay, J. (2015a). Citation classis published in knowledge management journals. Part I: articles and their characteristics. *Journal of Knowledge Management, 19,* 401–431. doi:10.1108/JKM-06-2014-0220

Serenko, A., & Dumay, J. (2015b). Citation classis published in knowledge management journals. Part II: studying research trends and discovering the Goggle Scholar Effect. *Journal of Knowledge Management, 19,* 1335–1355. doi:10.1108/JKM-06-2015-0086

Serenko, A., & Dumay, J. (2017). Citation classis published in knowledge management journals. Part III: Author survey. *Journal of Knowledge Management, 21,* 330–354. doi:10.1108/JKM-07-2016-0300

Sharma, S., Daniel, E. M., & Gray, C. (2012). Absorptive capacity and ERP implementation in Indian medium-sized firms. *Journal of Global Information Management, 20*(4), 54–79. doi:10.4018/jgim.2012100103

Stenius, M., Hankonen, N., Ravaja, Ni. & Haukkala, A. (2016). Why share expertise? A closer look at the quality of motivation to share or withhold knowledge. *Journal of Knowledge Management, 20,* 181–198. doi:10.1108/JKM-03-2015-0124

Tarhini, A., Ammar, H., Tarhini, T., & Masa'deh, R. (2015). Analysis of the critical success factors for enterprise resource planning implementation from stakeholders' perspective: A systematic review. *International Business Research, 8*(4), 25–40. doi:10.5539/ibr.v8n4p25

Terrell, S. R. (2015). *Writing a proposal for your dissertation: Guidelines and examples*. New York, NY: The Guilford Press.

Umble, E. J., Haft, R. R., & Umble, M. M. (2003). Enterprise resource planning: Implementation procedures and critical success factors. *European Journal of Operational Research*, *146,* 241–257. doi:10.106/SO377-2217(02)00547-7

Vandaie, R. (2008). The role of organizational knowledge management in successful ERP implementation projects. *Knowledge-Based Systems, 21,* 920–926. doi:10 .1016/j.knosys.2008.04.001

Wang, E. T. G., Lin, C. C., Jiang, J. J., & Klein, G. (2007). Improving enterprise resource planning (ERP) fit to organizational process through knowledge transfer. *International Journal of Information Management, 27,* 200–212. doi:10.1016/j .ijinfomgt.2007.02.002 doi:10.1016/ijinfomgt.2007.02.002

Ward, M. A. (2006). Information systems technologies: A public–private sector comparison. *The Journal of Computer Information Systems, 46*(3), 50–70. doi: 10.1080/08874417.2006.11645898

Yin, R. K. (2003). *Case study research: Design and methods* (3rd ed.). Thousand Oaks, CA: Sage.

Yin, R. K. (2012). *Applications of case study research* (3rd ed.). Thousand Oaks, CA: Sage.

Yin, R. K. (2014). *Case study research: Design and methods* (5th ed.). Thousand Oaks, CA: Sage.

Zhang, X., & Jiang, J. Y. (2015). With whom shall I share my knowledge? A recipient perspective of knowledge sharing. *Journal of Knowledge Management, 19,* 277–295. doi:10.1108/JKM-05-2014-0184

Zqikael, O., Levin, G., & Rad, P. F. (2008). Top management support—The project friendly organization. *Cost Engineering, 50*(9), 22–30.